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ANNIVERSARY EDITION

digit Fast Track to TECH CAREERS

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Happy hunting

It's hunting season. Job hunting that is. The climate has been rather bad for the hunting grounds too. It still is that time of the year when young minds are buzzing about the place. We bring you this Digit Technology Career guide because of the dozens of mails we get every week, from readers like yourself, asking us for career advice. Many of these letters sound almost like younger brothers and sisters asking for wisdom. They want to talk to the people that went ahead of them to shed some light on the paths that they just may tread.

Many of us have let serendipity nudge us into the roles we currently play as working professionals. As we went about interviewing professionals across industries for this it became obvious that many of the people at top levels also landed up in their positions with their own personal choice having little to do with it. What if they had picked a career path based on an informed decision?

That's exactly what we've gone about addressing in Digit's 8th Anniversary Issue Jumbo Fast Track. Our objective has been to demystify many of these technology career paths for college graduates as well as mid-level executives.

We first shortlisted 20 careers that we believed showed promise of offering a job pool of at least 30,000 over the next five years. We then vet this list with professors from around the country. We then presented this list to Careernet and they tweaked it further. They then lent us their domain experts to better understand the dimensions of each of these careers.

With a tighter, more focused list, we dove deep into each career to help you understand these fields better. From compensation packages to risks of the career, we have attempted to bring you an all round picture of each of these careers. Of course, this is not the most exhaustive list. Given the constraints of pages we had to be judicial. Some areas, like Web Technologies and Green Tech, which show plenty of promise had to be dropped completely, as each of those sectors deserved entire Fast Tracks to themselves.

For more discussions on Career Choices join us on Thinkdigit.com at http://snipurl.com/ioa8m

Jacob Cherian

The only way is UP

by Rishi Das, Co-founder & CEO, CareerNet Consulting

India, today, is poised to get into a higher growth curve – which makes us uniquely positioned with respect to our global colleagues. We are one of the very few growing economies today, which was though stalled a little because of the global meltdown, but is gearing up to get into the next level of equilibrium. With FDI opening up in key sectors such as insurance, telecom and education, the domestic market is all set to grow and would result in more employment opportunities. If anything, global recession which is making the western world bleed can prove to be a good opportunity for economies like us. However, technology outsourcing remains one of the key drivers of the India outsourcing story and is going from strength to strength and setting pace for the other business domains and verticals.

IT outsourcing created the industry in India which was the sunshine sector in the decade of 1990s. Although it created a unique positioning for us and put us on the map of the global business, we found ourselves in the lower end of the spectrum. What started out as a workforce augmentation model, graduated to more routine maintenance and backend management office. However, as we consolidated our position as the global back office, we also invested in ourselves and developed technology and business competence which could add more value to the customers. Today, corporations across the globe are setting up captive centres in India or working through partners to deliver core business and technology solutions. Organizations are now looking at India as a co-located geographical location where core functions such as product conceptualization, R&D and architecture and design and operations are carried out. This is a position of major strength which puts India as a front runner in the race with the other BRIC countries.

One another interesting trend which has come out the prevailing economic condition is that a lot of functions which were previously not outsourced are today delivered out of India centres. We are witnessing a surge in the outsourcing of functions such as IT infrastructure management, technical writing and documentation, professional services and business analytics. Captives and outsourcing partners have developed a high level of maturity in outsourced delivery of the IT infrastructure, technical writing and business analytics. Traditionally, flavors of professional services have been delivered through India centres over a decade now. However in the current context, we are witnessing a surge in the amount of work that is getting outsourced to India. The maturity index for the professional services in the Indian organizations is getting higher by the day as skilled force is now available to be deployed. In order to service the demand of skilled manpower in these emerging sectors, the academic landscape is shaping to provide the workforce. Several finishing schools / academic institutions have now sprung into action by providing specialized training to entry level people thereby providing a shot in the arm to companies which are looking to attract the requisite talent.

Another important aspect is that in the current global business context, India, amongst other developing nations, is being looked at as an important emerging market. Though this premise has taken a hit due the prevailing economic scenarios; however, the idea of India as a market is fundamentally correct. India is one of the most exciting emerging markets globally and this has created a new set of opportunities both for global as well as domestic players. Today, we are witnessing a lot of state-of-the-art technology start-ups which are emerging out of India with the India-based enterprises as customers. A lot of western firms are setting up operation delivery centres here to cater to domestic demand. Our innovation and R&D will pave way for global products – something which will be a reality in times to come. There will be a slew of global products and services which will emerge from India in times to come. A brilliant example is Tata Nano, which couldn't have been developed anywhere except India will be one which will be marketed the world over. Several industries such as telecom, education and manufacturing are gearing up for next level of product innovation which will take the world by storm.

This is the start of a great movement which will help create India as a consumer and our export-led industry will start serving the domestic needs. The challenges of delivering business in India comes with its own set of nuances and the companies in this space are innovating their business models and delivery mechanism to deliver quality, while maintaining profitability. The Indian customer is quality and cost-conscious which makes it difficult to cater to us. However, all the major Indian companies today are more open towards outsourcing non-core functions to competent partners. The Bharti-IBM deal is proof enough in itself that Indian companies have an appetite to outsource non-core functions and that with proper oversight and governance; it can be very profitable for the enterprise. The market is ripe for more such deals to follow and is a question of when and not why any longer.

All in all, we are entering a very exciting phase where a lot of new business will scale up or be built to cater new emerging sectors and markets. This will herald the emergence of a whole new set of technology platforms which will be built to deliver scalable business. In here lies significant business opportunity and tremendous employment potential. Make no mistake, the customer outlook from now on will be much tougher, but companies providing quality of service and proper customer focus will receive unprecedented success. The mantra is simple – constant innovation to provide value to end customer. The ones who finish the loop earlier will be the leaders for tomorrow.

digit

Credits

The People Behind This Book

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Editor-in-chief	**Edward Henning**
Editor	**Robert Sovereign-Smith**
Editor-at-large	Ahmed Shaikh
Head-Copy Desk	**Nash David**
Writer	**Gunjan Aggarwal** **Bejoy Suri** **Saransh Sugandh** **Jacob Cherian**

DESIGN AND LAYOUT

Layout Design	**MV Sajeev**
Cover Design	**Kabir Malkani**

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Jargon buster

Before we delve into this FastTrack here is a lowdown on some of the more esoteric terms you are likely to encounter

CAGR: An abbreviation for compound annual growth rate, CAGR is an indication of the returns on an investment over a period of time. The CAGR is not a measurement of the actual returns, but a measure of the growth of an investment over a specified number of years, without taking into consideration the growth of the investment in each of those years. This is called a "smoothed annualised gain". CAGR is calculated by using the formula [(Return/Investment)^(1/years)]-1

IP: Intellectual Property are the assets created by the mind, and the laws in various nations that protect these assets. IP may or may not have a physical manifestation. Processes, which may be a trade practice or the designs of a machine, are also protected under IP laws. The copyright for works of art are also under the purview of IP.

SoC: System on a chip, a microchip design which fits in processor components, memory components of various types (RAM, ROM and Flash), various clocks and interface points for power supply and I/O devices, all on a single circuit board.

DFT design engineer: The Design for Test engineer has to devise test processes for prototype loadboards. These are circuits that resemble the chips, but are not manufactured in large volumes and are more costly. The Design for Test engineer, has to make sure that the chip is suitable for the particular application before it is fabricated.

EDA: Electronic Design Automation is the process of using software for laying out the design of a chip. The different components of a chip can be laid out by different EDA engineers separately, starting from a basic floor plan, then merged together in layers. Most modern EDA software allow for some kind of simulation based testing of the chip design.

VHDL: Very (High Speed Integrated Circuits) Hardware Description Language is a method initially used by the US defence services to abstract the lengthy and complex documentation of chips in simpler means. This allowed for useful and faster decisions based on chip design without detailed analysis of the implementation. VHDL is the industry's leading standard, although there are other hardware description languages.

MEEMS: Micro Electronics Electromechanical technologies use methods of chip fabrication for designing other kinds of electronic devices, which could be a radio or a light/solar panel. The advantage of MEEMS is that it is possible to make tiny, wireless devices that are low on power consumption.

Prior art: Prior art is information about a device, process or idea that has been made available to the public. A patent application is rejected, if the design of the patent was commonly available, or even known to members of the general public before the patent is applied for. The most popular example of this is Arthur C Clarke's thorough descriptions of satellites, due to which no one could patent them.

Patent landscaping: Patent landscaping is used for research groups, scientists and companies to plan and strategise. Patent landscaping maps out the relevant patents for a technology field. Prior to a design, patent landscaping can be used to identify areas for research, and possible creating new assets by applying for patents. Post the design process, patent landscaping can be used to identify possible infringement, and make the product reach the market as fast as possible.

Tipping point: The "Tipping Point" is an idea outlined by that name by Malcolm Gladwell. According to Gladwell, ideas change society by behaving like viruses. According to him, change is marked by an "epidemic" of new technologies. The concept is similar to Richard Dawkin's "memes" that are ideas that spread from person to person, only more active.

Captive centre: Captive centres or units, are operations of a company wholly owned offshore. The operations are on foreign territory, but are controlled closely as a branch of the company, instead of just dumping the work on an outsourcing company.

Third-party units: Third party units are operations where the work, or parts of it is outsourced to a company on foreign soil. This is a common practice for reducing the cost to the company.

First contact: First contact resolution involves solving the problem the first time a customer calls in. The benefit is customer satisfaction, but the flipside is that the employees will be occupied for longer times on each call.

MBO: Management by objectives is a process where the administrators or the management of the company and the employees have a written or verbal agreement on all the objectives of the individual employees, as well as that of the company.

CDCP: Certified Data Centre Professionals is a certification by EPI, a British company. It is a course that standardises and guarantees a certain degree of proficiency to the certified individuals.

CMM: Capability Maturity Model was developed by the Carnegie Mellon Software Engineering Institute to assess the capability of software engineering companies to deliver on a contract. There are various "levels" of CMM certification, from 1 to 5. These levels stand for Initial, Repeatable, Institutionalised, Managed and Optimised. The levels describe the process within the organisation. Level 3 is considered prestigious.

CISA: Certified Information Systems Auditor are information system auditors, controllers and security professionals that are certified as meeting the requirements of Information Systems Audit and Control Association.

CISM: Certified Information Security Manager are information security overseers that are certified as meeting the requirements of Information Systems Audit and Control Association.

CISSP: Certified Information Systems Security Professional are Information Security managers that are certified by the International Information Systems Security Certification Consortium. There are about 60,000 certified individuals worldwide.

Analyse This

A bank that has nearly 1,000 branches with more than 5 million customers wants to know — of its customers how many will default on payments? Should it consult an astrologer? Is it a magic number, or the CEO's gut feel? No, there is no magic wand or gut that guides them on how to manage this risk. It is an analytics company that gives power into the hands of the decision makers to cover this risk. A career in Analytics pays well and the practitioners we spoke to seem to love the challenges their job throws up.

⦿ Why bother?

There will be a huge demand for Analytics professionals in 3-5 years. Over 50,000+ jobs over the next 5 years

⦿ How do I progress faster in this profession?

Good Quant Skills, Passion for numbers,
Eye for Detail, Team Player.
A software engineering course with a strong knowledge and idea of data mining, processing and familarity with SQL or the software (SAS, SPSS, SQL Server, Oracle, Teradata, Clementine)

⦿ Where am I ten years from now?

Fresher -> Experienced Analyst -> Managerial Roles -> Head (Analytics) / AVP / Business Leaders

⦿ What's in it for me?

Excellent compensation.
Very interesting and challenging profession.

What is it?

Analytics can be defined as the extensive use of data for statistical and quantitative analysis, explanatory and predictive modelling and fact-based decision-making. Analytics closely resembles statistical analysis and data mining, but tends to be based on solving a specific business problem by gathering relevant data and information and analysing it to take an informed business decision.

Analytics is one of the sunrise careers of not just the Indian digital economy but also the global economy. While careers in data mining and analytics have typically been offered by the business process outsourcing sector under the sub-brand of knowledge process outsourcing, increasingly robust demand for analytics professionals has come from information technology firms, banks, telecom companies and other sectors in India.

Why is it needed?

Firstly, the data that is generated by most organisations is bulky and unstructured. This data has to be mined to extract the relevant information. This is an opportunity for “data miners”. Here, you need a smart IT professional to work with software and Excel sheets to bring this data into a readable format.

Once the data has been generated it requires quant (quantitative) skills to analyse and give actionable steps for the organisation. For instance, whether it is the banking industry, insurance, telecom or retail, they do have volumes of data on customers, their transactions, personal details but all of this has to be analysed by smart minds to give a more engaged customer experience and to increase repeat sales volumes.

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The outsourcing industry has made India a destination for more specialised analytics-based services, enabling global organisations to make enduring decisions. This could involve simple solutions such as keeping organizations in touch with the alerts and signals produced by their respective industries as they go through their life cycles. This involves generating valuable information on how the industry is changing, growing, consolidating and keeping an eye on the competition. This helps you, the analyst, to identify and respond to major changes within your macro environment.

With more people and businesses going online everyday, web analytics is poised to become one of the hottest career trends of the next five to 10 years (Gartner). More metrics will be used to measure the effectiveness of an e-business in terms of operations, customer experience and return on investment; web data analysts help enterprises prioritise web channel activities and solutions.

The scope for Analytics

Analytics services have been identified by

NASSCOM as one of the six hottest tech sectors expected to grow significantly in the next few years.

While there have been widely varying estimates from different industry research organisations on the current size and growth rates of this market, independent research suggests that about 4,000 professionals are employed in various analytics services businesses in India and this talent pool is rapidly growing at about 40 per cent annually. The key limitation of these estimates is that there isn't an industry-standard definition for what constitutes "analytics services", which is a subset of what is now commonly termed the knowledge services or the knowledge process outsourcing (KPO) services industry.

In recent years these jobs are with several specialist service providers and global third-party services providers as well as captive centres that have set up analytics services teams to feed such growing market demand.

Key drivers of growth

The key driver of growth is the fact that any industry and any company would require this service. Whether they build this skill set in-house or outsource it to a vendor; in the future this service would be required in a big way. However, various industry research organisations have opined that enterprises are more likely to source knowledge services from their in-house or captive centres, rather than outsourcing such activities to third party service providers. The reasons for this include the business sensitivity of the data, inherent intellectual property protection issues and the need to build and maintain such organisational skills and capabilities in-house for sustained competitive advantage.

Whether in-house or outsourced, the industry has to acquire talent or build over time to meet the growing demand. In India, due to the increase in outsourcing and software industries, data mining has become an important segment of technical work. To the world, India is well known as the back office. Apart from customer care and tech support, many outsourcing companies are venturing into data mining with the increase in demand from overseas. The analytics services industry thus presents the opportunity for India to transcend the realm of labour arbitrage into high value professional services with higher revenue and margin realisations. Five years ago, the volume of outsourced work to India sent a great deal of fairly low-end work over here. Today, however, the quality of work being outsourced to India has improved, and we can expect more high-value work to come in.

Source: Analytics Services in India: A Talent Perspective, Dec 2008, Careernet Research Publication

Types of data Analytics:

❑ Reporting or Descriptive Analytics

As organizations go about their business, they gather a lot of information on sales, volumes, prices at the distributor level, retailer level and about competition. This information helps them to get a sense of the current health of business and possible future trends.

❑ Modelling, or Predictive Analytics

Predictive Analytics refers to the art and science of analysing and finding patterns in data to build-up predictive recommendations. These recommendations can range from which type of customer to call by phone for a credit card or insurance, to which type of mobile scheme to offer to a cell phone customer by SMS, or to which kind of customers are likely to default on the loans they have taken. Extensive use of econometrics and statistics is undertaken.

❑ **Data-driven strategy**

This is also called test-control or champion-challenger testing. This is done by segmenting the data population into test (on which a new strategy called the challenger strategy is to be tested) and control (which uses an existing strategy called champion strategy). Building association rules which describe which parts of the product or customer data are clustered or co-related together are also part of analytics.

Basic domains within Analytics

Data-driven analytics, by definition, thrives in industries which have large amounts of data and high-volume transactions, and which need systematic and scientific analytics to cut costs and grow sales. The following domains offer employment opportunities to both newcomers and experienced Analytics professionals. These can be both in domestic firms, captive outsourcing firms, or third-party business process outsourcing companies.

❑ **Retail sales Analytics**

Retailers require analytics on outlet level data on uptake of particular items, inventory buildup, etc. All this helps them to improve their supply chain as well as sales. For example, a retailer found that sales of chocolates and chiclets increased when they were taken out from the food counter and kept next to the cash counter. In the US, every Walmart store has two dedicated analytics personnel tracking sales, shelf-space, pricing info and inventory.

❑ **Financial services Analytics**

Financial services use analytics extensively. This is because they are in a very competitive field, have millions of customers and a lot of transactions. Analytics help them segment customers and make targeted offerings. For example, if client data shows a spurt in spending, they also are likely to contact you with a personal loan offer.

- ❍ **Risk and credit Analytics**
- ❍ **Marketing Analytics**
- ❍ **Collections Analytics**
- ❍ **Fraud Analytics**
- ❍ **Pricing Analytics**

❑ **Telecommunications**

A growing field in India based on the wealth of information gathered by telecom firms on the calling, SMS and other VAS (value added service) usage habits of customers.

❑ **Pharmaceutical or clinical Analytics**

Clinical trials depend on the test and control of thousands of patients trying out new drugs. Clinical trial analytics focuses on a large number of variables that may or may not affect the drug response.

❑ **Supply chain Analytics**

Supply chain analytics comprises inventory optimisation, tracking turn-around time, multiple reports, and how to minimize the distribution costs.

❑ **Transportation Analytics**

Face-2-Face with practitioner

"My role in this company is that of an astrologer, I answer questions for clients and predict future scenarios based on numbers from the past."

Anurag Kapoor
Group Head
Data Analytics
The Smart Cube

Transportation analytics, while covered more extensively in the field of operations research, seeks to minimise route length, fuel costs or fare pricing.

❑ **Online or web site Analytics**
Web site analytics focuses on analysing traffic to the web site and how to retain visitors on the web site for a longer time or encourage them to purchase more goods. It also involves a bit of search engine optimisation to make sure the web site is high up in the results provided by search engines.

What is your career path as an Analytic?

Typically, everyone starts with an analyst role. It starts with analysing operational data. As the analyst grows in the organisation and gains business acumen, he is then capable of getting into business analytics. The analyst would then have opportunity to become a consultant with firms like McKinsey or Boston Consulting Group.

Career progression in analytics follows the broad pattern as follows:
❑ **Fresher:** As an entry-level programmer or analyst, you would be required to write code to generate reports, or clean data to prepare it for analysis. You would also be expected to pick-up nuances of business data, what data is usually wrong, what are the outliers to spot, besides learning the programming language to retrieve and manipulate data. This phase could last for up to two years. As you grow, you will also assist in recruiting and training freshers.

❑ **Experienced Analyst:** For a period of three to five years of relevant experience, you would then be working as a Senior Analyst / Assistant Manager with official duties in data analysis with some people responsibilities. Depending on your aptitude and organizational abilities, you can tweak the level of business exposure, people management with the amount of technical analysis / skills.

❑ **Managerial Roles:** After a period of up to five years, you would be full-time dealing directly with clients, people management, requirements gathering, and translation to technical details for your team. This will also involve recruiting, mentoring junior members and technical training.

❑ **Head (Analytics) / Associate Vice President / Business Leaders:** You can expect to be a business leader within eight to ten years of full experience. The focus will be to grow your team size, maximise customer satisfaction, and deliver innovative analytics that positively impact business revenues.

Why did I choose this career?

It happened! I did not plan to get into this career but it was the first job I took. However, I can tell you the reasons that have made me stick to it.

- **Scope of learning:** This career poses a new scope to learn every day. Different clients have different set of queries to be answered. This gives a new perspective and unmatched knowledge exposure.
- **Exercising the mind:** I know my mind still works. Working with numbers gives me a high. It lets the mind draw inferences on different situations and come up with smart answers.
- **Creativity:** This career has allowed me to use my creativity to unleash the power of numbers that is hidden in the volumes of data given to us.
- **Culture** – The culture of the organisation is professional and healthy,

bringing out the best in me and my team.

What are the required skill sets?

The most important skills required to work in this job are as follows:

- **Logical and analytical thinking:** I was not from a statistics background but have been able to do well because of my logical thinking.
- **Eye for detail:** Data Analytics is about putting the smallest pieces together to get to the big picture. It is very important to have an eye for detail. You can't afford to go wrong; you have to be 100 per cent accurate and that can only come from analysing to minute detail.
- **Passion and ability to work with numbers:** A number-crunching role has to be driven by a passion and ability to work with numbers. There has to be a huge comfort level.
- **Work in teams:** For every project, you have to work in a team and deliver the solution for a client. You have to look at the bigger picture and work towards that goal for the benefit of the organisation.

Face-2-Face with Employer

"Analytics is currently neglected in India. We expect to see jobs in this space for as many as 1,00,000 people over the next five years."

Ashish Gupta,
COO of Evalueserve

What about the Mind Set?

It's not a lazy man's job! It requires lots of hard work, sense for numbers and technical capabilities. Knowledge of packages such as SAS and SPSS is helpful in this career. Business acumen as a mind set is critical to the profession; one needs to know the over all business environment of the client, economic scenario and how they should make their decisions.

Attributes needed for the job include statistical skills, IT-savvy and project management experience. Detail-oriented; excellent analytics skills and the ability to translate and conceptualise statistical information to determine user habits and trends; an understanding of web navigation and user habits; HTML knowledge required, Java and Active Server Page experience come in handy.

Analytics require strong attention to detail, quantitative acumen, hard work, and ability to think creatively in terms of how to design test and control for strategy building. An ability to pick up programming languages fast is a must as the large amounts of data is manipulated using software.

Sample Job Description for a Risk Analyst

Summary of Position

Provides analytical and/or MIS (Management Information System) support for various credit policies, risk and/or marketing related functions.

Principal Accountabilities

- Provide support for analytical research projects and/or statistical models to include project design, data collection, database design, analysis and presentation of results.
- Conduct cost and profitability studies of customer groups, merchants and/or loan types for business unit operations. Evaluate and implement internal and external credit scoring using traditional and advanced forms of predictive technology.
- Complete analysis and document results of alternative risk management options and credit risk issues. Design and prepare analyses of operating data; formally present findings to management.
- Analyze loan and customer credit risk performance using corporate databases. Utilize external scoring and/or management software packages to aid in manag-

ing account acquisition and portfolio management.

- May design and/or write technical programs for statistical analysis of portfolio and/or credit bureau performance and monitoring.
- May prepare exhibits and supporting material and develop recommendations for credit and pricing policies, credit bureau usage, bulk acquisitions, new loan or merchant program structures, profitability/pricing for accounts and portfolios and provide revenue, cost, delinquency and loss forecasts.
- May assist in establishing, monitoring, evaluating, developing and implementing strategies for new account acquisition, credit limit setting and account management.
- May ensure account acquisition or account management systems are operating efficiently. May code, test, program and implement new policy changes for account acquisition or account management systems.
- Adhere strictly to compliance and operational risk controls in accordance with company and regulatory standards, policies and practices; report control weaknesses, compliance breaches and operational loss events.
- Complete other related duties as assigned and support the company's diversity programs.

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Kale Consultants
Fractal Analytics

Knowledge, Skills and Abilities

This position requires an individual with:

- One year proven statistical analysis and/or MIS experience, or equivalent. Knowledge and understanding of financial services preferred.
- Bachelor's degree in mathematics, statistics, finance, economics, related field or equivalent experience; Master's degree preferred.
- Good organisational, analytical, problem-solving and verbal and written communication skills.
- Proficiency with personal computers as well as pertinent mainframe systems and software packages.

Employers can be either an organisation with a captive analytics unit or a third-party analytics firm

❑ **Captive:** There are captive analyst divisions, where the analyst works specifically with a certain vertical. For example with AOL you could work

Career growth over time

Experience	**Position**	**Pay Growth**
Captives	Tier-1 schools	Tier-2 schools
Entry Level	7-8 Lakh	5 Lakh
Mid-level 4yrs	10 Lakh	8 Lakh
7-8 years	13-15 Lakh	10-12 Lakh

3rd-party firms are paid usually 20 per cent less than the captives.

Please note: This graph does not represent the compensation package of any one company. It is an approximate based on discussions with experts across companies.
Salary figures in Lakhs

purely on web analytics determining how to increase traffic or conversion rates. In Dell you could be looking at how to optimise inventory. Therefore, you would be specialising in a specific domain.

❏ **Third-party analytics firms:** These are firms that are hired by companies for specific projects or for a certain time period. These analysts cut across various industries, thereby gaining a broad range of experience.

What makes people successful in this career?

Krishnan Venkata, with Latent View Analytics in Chennai, says that people who get into this field after five to 10 years of experience in a particular business domain have a definite advantage: "When you have an analyst with a pure mathematical and statistical background, very often the strategies turn out to be useless as it is completely devoid of on-ground business reality."

Risks

If you want to change tracks (to get out of analytics) after spending part of your career in it, you would need to learn new skills. The applications to other industries are limited.

What are the alternate mid-career changes that are possible?

Since it is such a young field in India, there are few examples of people making mid-career switches. Very often, analysts take up further studies in order to upgrade their skills. The applications of these skills to another industry all together are limited. Many analysts go on to become consultants.

Krishnan Venkata, an analyst with Latent View says, "It is never easy to change careers, but there are natural roles in different lines of businesses to which people can transition. For a Sales / BD person, he could move to other high end services / product selling roles in firms in IT / BPO / consulting / research, etc. For a delivery person, it would be a harder shift but the natural cross-road is to be a domain expert / consultant. For example, an analyst in financial services analytics could grow to become a domain expert / consultant in the field of financial services."

He says that the transitions people make at the management level are shifts to strategy consulting or account management in similar lines of businesses, such as KPO / BPO / IT services. There have also been people who move into equity research / financial analysis / investment banking. At the analyst level, since some of the skills developed are programming and statistical modelling, they could move to a domain or consultant role.

Resources for further reading

- http://keysoft.co.in/training.aspx
- http://www.learn4good.com/great_schools/computer_science_schools_in_india.htm
- http://www.rediff.com/money/2001/sep/01riti.htm
- http://www.exforsys.com/tutorials/data-mining.html
- http://www.financialexpress.com/news/take-your-pick-nasscom-identifies-six-hot-tech-sectors/79935/0
- http://www.careernet.co.in/pdf/CareerNet-TEG-Analytics-Services-Study-2008.pdf

Educational/training institutions

In most cases, a software engineering course with a strong knowledge and idea of data mining, processing and familiarity with SQL or associated software (SAS, SPSS, SQL Server, Oracle, Teradata, Clementine) help. But there are a few courses available which include data mining.

- SAS R&D India (Pvt.) Ltd., New Delhi
- PGDITM Course, National Institute of Industrial Engineering, Mumbai
- PGPM, Lal Bahadur Shastri Institute of Management, New Delhi

Please note: This list is not exhaustive and is compiled based on discussions of experts across industries

Intellectual Property Rights Management

Inventors would be paupers it weren't for lawyers. In other words, if it weren't for lawyers, inventors would not be able to gain anything more than fame for their efforts. Lawyers who understand technology, or technologists that understand law are essential for innovation. There is no other way to file a patent. Intellectual Property Rights (IPR) are essential to reward innovative thinking, which in turn contributes to mankind tremendously. If an inventor couldn't protect his idea from being ruthlessly ripped off, then he's got little reason for creativity. The big-picture impact is that the human race suffers.

- How do I progress faster in this profession?
  Engineering and diploma in IPR Law
- Where am I ten years from now?
  Possibility of being a consultant
- What's in it for me?
  This is an extremely interesting job profile as the IPR Specialist will always have a peek at technology that may be released even five years ahead of public launch.

Why bother?

- 50,000 patents filed in India last year as compared to 5,000 about five years ago.
- 450,000 patents filed in China last year
- 400,000 patents in the US
- Roughly about a million patents are filed every year around the world.
- India's first IPR case verdict expected in next 3 years. Increased demand for IPR Specialists expected after that

What is it?

IPR is a term that covers patents, trademarks and copyright. Of these, the most relevant to you as a technology enthusiast is the patent. To file a patent there are sub-processes such as prior art searches, patent drafting, patent landscaping. At first glance it may seem like a lawyer's job. On closer examination it becomes clearer that only a qualified technologist can excel in this field.

This field basically ensures that the inventor of the technology gets what he deserves. This means that the invented product or process would have to be unique. It was easy to recognize an innovation a 100 years ago. For instance, a 100 years and three months ago (March 2, 1909), the first US hybrid patent was granted to German-born inventor Henri Pieper. It was awarded for something called the "Mixed Drive for Autovehicles," In his application, submitted in 1905, he wrote that:

"The invention...comprises an internal combustion or similar engine, a dynamo motor direct connected therewith, and a storage battery or accumulator in circuit with the dynamo motor, these elements being cooperatively related so that the dynamo motor may be run as a motor by the electrical energy stored in the accumulator to start the engine or to furnish a portion of the power delivered by the set, or may be run as a generator by the engine, when the power of the latter is in excess of that demanded of the set, and caused to store energy in the accumulator."

Back then, Pieper covered the entire concept of a Hybrid car under the banner of "Mixed Drive for Autovehicles". The idea was revolutionary. Today, the Toyota Prius is the world's best-selling hybrid car and comprises of nearly 50 percent of all sales in the hybrid segment. The car has over 2,000 patents that cover the minutest of incremental innovations. Most of these 2,000 patents are tiny evolutions over existing technologies.

In other words, leaps forward are constantly getting smaller. It is getting increasingly difficult to firstly, spot these evolutions, secondly check if anyone else has thought of the idea already, and thirdly articulate why your evolution is unique. This is essentially the job of the IPR Specialist.

The Tata's Nano is a great example of how innovation originating from an Indian company requires patent protection. An example of the ingenuity of the car is that the car has a two-cylinder rear-mounted petrol engine connected to a single balancer shaft. Also, even though the Nano's shell is smaller than the Maruti 800's, it actually has 20% more seating space. The modular design of the car also allows it to be transported as components, thereby significantly cutting down on distribution cost. If all these innovations are patented right, then all these will collectively give Tata a head start in the small car segment, that any aspiring competitor would have to struggle with.

The Growth Story

According to the 2009 projections, NASSCOM believes that the software industry will grow by 15 per cent over the next financial year. It projects a 14.4 percent growth of software product and engineering services and expects a revenue of $7.3 billion. The software company is only growing, and with it patent and IPR management jobs will grow as well.

The head of a leading IPR management firm told *Digit* that the number of patents filed at the Indian Patent Office last year was around 50,000, as compared to 5,000 about five years ago. The Chinese on the other hand filed a gargantuan 450,000 patents last year, beating the US Patent Office at 400,000 patents in the same time period. Roughly about a million patents are filed every year around the world.

Key drivers

As technology progresses worldwide, there is an increasing need for patents to be filed for new developments. The opportunities in India are increasing because of the amount of work being outsourced to India. The task of identifying monetisable technologies, comparing it with existing technologies and then following it up with communications with the patent office is a huge and expensive task. It therefore makes sense to outsource such processes to India where there is a large pool of engineering graduates that can consider this as a career option.

In India, the career of being an IPR professional is very young. One of the first few IPR violations comes in the form of the Novartis-Ranbaxy case, which was reported last year. Ashish Gupta, the COO of Evalueserve believes that once the verdict is passed on that, we will see the tipping point for IPR law as a career path. Once that happens and the value of the IPR Specialist is realised, more Indians will want to get into this field.

Nikhil Sharma has been in this industry for nearly four years. He recalls how back in 2005 there was a reform in the Indian Patent Act which allowed the Indian Patent Office to grant process patents as well. Till then it was limited to product patents. Then in 2006, a couple of IP cases were registered in Indian courts. These were indicators that there was an increase in consciousness about the importance of IPR. This helped him decide that this was a promising career to look at.

Possible career paths

Dividing IPR Management across industries would be as follows:

- IT and Telecom Technology
- Pharmaceutical and Biotechnology
- Energy, Oil and Gas Technology

Of these three options, currently the most business is focussed on IT, Telecom, Pharmaceutical and Biotechnology. However industry players believe that the next 20 years will belong to IPR Management to the Energy field. There are many other forms of patents based on industry.

Within each of these paths, it can further be divided into the following roles:

- Commercialisation analysis
- Identifying useless IPR
- Determining the royalties
- Market dynamics of a technology sub-segment

The Role

The role of an IPR specialist is to help the inventor gain patents on his invention. The inventor can be a large corporation, a small business a team of scientists and even a lone inventor that's working out of his garage. The first step taken by the IPR specialist is to understand the invention itself. He then researches whether such a technology already exists in some form. After this he goes about understanding how best the invention can be patented so that maximum monetisation is achieved. The final step is to file the patent with the Patent Office.

Face-2-Face with practitioner

"My role is to help clients come up with a better, efficient and monetarily benefiting IP strategy for their inventions. Come and test the waters of this field. There is never a dull moment around here,"

Nikhil Sharma
Group Manager
IP Division, Evalueserve

The IPR Specialist in India does about 80 per cent of his peer in the US. This is because in India the specialist does not pursue litigation. "We can support the litigation with our research, but we cannot sit with you on the negotiation table," says Nikhil Sharma. Once Indian courts see more action in the IPR space, we can expect more IPR specialists that can apply their skills in court.

"The thrill is picking up an unstructured problem and then fixing it. The work culture is extremely young and therefore the energy is enormous. Two hours of brainstorming in a room with these guys is quite a high. Other than that we interact with people dealing in R&D for over 20 years, CFOs and CTOs, and so the level of interaction is at another level all together," he says, illustrating the high points of the job.

Skill sets

An IPR specialist needs a degree in science or engineering and then supplement this with a degree in law. Considering that IPR management covers a number of industries, specialists from/for each industry is required. If the professional is moving laterally from, let's say, being a telecom engineer and into IPR Management of telecom technologies, then he comes with a certain amount of skill sets already. From here he would have to gain the legal acumen to understand how to apply his skills in IPR Management.

A fresher from an engineering college on the other hand can join a firm and gain the skills in house. Training of a fresher usually takes two to three years.

Impact of background

The brand of your graduate or PG college helps only initially. After about two years this disparity disappears and growth is based purely on performance. A thorough knowledge of a technology field will always be preferred to high scores in tests. Experience gained on the first jobs in specific domains, like telecom or biotechnology, can be applied in the respective fields within IP management.

An employer's perspective

Evalueserve, among other things, works in IPR. They have a team of 250 people that work in this division. Ashish Gupta, the COO draws on the analogy of real-estate to describe the value of IPR. He points out how the number of patents filed in India has grown nearly ten-fold as compared to four years ago. He looks over to the Chinese and looks at how they filed away 450,000 patents last year, while the US filed away 400,000. The number of patents being filed in the US is growing at a rate of 6-7 per cent, while the number in India is projected to grow by 15 per cent this year. He also points out the

Face-2-Face with Employer

"If you were to look at an invention as a plot of land, then patents is the boundary wall of this innovation. We have seen claims written so badly that they don't even cover 30% of the total potential of a patent."

Ashish Gupta
COO, Evalueserve

Basic skill sets are:

- **Deep domain knowledge**
  A base of deep domain knowledge is needed to even start thinking in this direction. Science background with law expertise are preferred.
- **A constant desire to learn**
  This is the driver for an IPR specialist to examine various technologies
- **Researching**
  There is a large amount of research that is required to ensure that the process or product being patented is unique.
- **Strong communication skills**
  There is a large amount of team interaction that is required.
- **Knowledge of the legalities involved**
  At the end of the day, this is a legal matter.
- **Command of the English language**
  As documents have to be written in the legal language, the exact usage of words is of utmost importance.

shortage of patent lawyers in Europe. Now, he believes India is heading for a tipping point in the next three years, when the value of an IPR attorney will truly be discovered. This event, he believes will be marked by the verdict on the Novartis-Ranbaxy case. “The judicial system in India is yet to learn how to pass judgement on an IPR case,” he says.

His team of 250 people are divided among 1. IT & Telecom, 2. Pharmaceutical & Biotechnology and 3. Energy, Oil & Gas in the ratio of approximately 10:10:5 respectively. He believes the most promise lies in Energy, Oil & Gas.

Potential employers

Engineers, biotechnologists and scientists in this field are usually employed at companies or institutes where they are involved in research and development. The objective of these employers is to find a unique way to solve a problem, gain the intellectual property rights to that solution and then market it.

A large number of organizations outsource their legal service requirements to centers in India. Technology Professionals can seek employment in either captive centers or third party units.

❑ Captive centers

An emerging trend in the industry has been the off-shoring of legal services by foreign law firms establishing units also known as captive units in India. Captive units are the preferred mode of outsourcing for organizations out sourcing high-end critical work. Most foreign law firms in India operate through this structure for want of greater control on areas related to their core competence and business. Issues relating to client confidentiality and risks of unauthorized practice of law are also some of the key reasons for operating through the Captive units.

Examples for Captive centres

GE
Sun
Microsoft
Cisco
Amazon
IBM
Ranbaxy
Dr Reddy’s

❑ Third-party units

These service-providers are law firms that either cater to domestic or foreign companies. The law firms themselves could be a foreign company with an arm in India. Many of them provide off-shore services to foreign companies. Third-party units have the advantage of greater flexibility as well as greater expertise

Sample job description

Responsibilities:

- Responsible for evaluating compounds in in vitro and cellular models
- Development of newer and innovative methods of testing compounds using the methods of molecular biology, gene expression, cell biology and enzymology
- Experimentation using the methods of biochemistry and cell and molecular biology
- Management and maintenance of the cell culture facility
- Management and maintenance of the radioactivity facility and the radiation safety program
- Supervision and training of scientists Participates in cross-functional compound development efforts as applicable
- Participates in the selection, contracting, and day-to-day management of external suppliers involved in the analysis of compounds.
- High quality scientific reading/writing
- Maintenance and protection of intellectual property (Research schemes, journals, analytical data, material/product safety data sheets etc).
- Participates as appropriate in the human resources activities of the department (staffing, training, performance management, and employee development).

Qualifications/Requirements/Skills:

- Ph.D., in Biological Science in the broad areas of molecular biology, cell biology and biochemistry or immunology with 8+ years of relevant, hands-on experience.
- Experience in management of personnel
- Ability to work independently and flexibly and to adapt to changing priorities.
- Excellent interpersonal skills

in the field. Third-party units include pure-play offshore legal service providers. There are also law firms such as *Anand & Anand* that hire engineers for IPR-related work.

Examples of Third-Party Units

IP-Pro
Evalueserve
Intellevate
BPO third parties who also provide legal services such as Evalueserve, Office Tiger

Roles in the company

❑ **Managerial:** The growth along the managerial path demands team interaction. That path is typically:
  - **Analyst**
  - **Senior Analyst**
  - **Manager**, with a team size of 60-70 people.

❑ **Knowledge specialists:** In this role an individual dedicates his time to specialising to a specific technology. Deep domain knowledge is the priority.

Risks of this career

The potential risk in this field is that it is easy to get straight-jacketed into a role, as right now the opportunity in this field is still not clear.

Possible mid-career changes

In India, the field is too young to draw an ultimate goal in the career. So far, it has been observed that people with experience in IPR go in search of entrepreneurial prospects. Many of them return to studying, before continuing with their career. People from a third-party IPR firm also have been observed to have moved to captive IPR departments where the pay is usually higher. Others have pursued their love for research and join R&D teams in their respective technological field.

Schools and certifications to consider

- Post Graduate Diploma in Patent management and IPR
  Academy of Intellectual Property Studies
  Mumbai

- Post Graduate Diploma in Patents Law
  NALSAR University of Law
  Hyderabad

Career growth in this industry

Experience	Salary (in lakhs)
Entry Level	5.25
4-5 Years	13.5
8-9 Years	30

Please note: This graph does not represent the compensation package of any one company. It is an approximate based on discussions with experts across companies.
Salary figures in Lakhs

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  New Delhi
- Postgraduate diploma program in Patents & IP
  Global Institute of Intellectual Property (GIIP)
  New Delhi
- National Institute for Intellectual Property Management
  Nagpur
- Patent Information System, Nagpur

Please note: This list is not exhaustive and is compiled based on discussions of experts across industries

Resources

- http://tinyurl.com/o7q6jz
- http://tinyurl.com/rb2ooc
- http://snipurl.com/int3h

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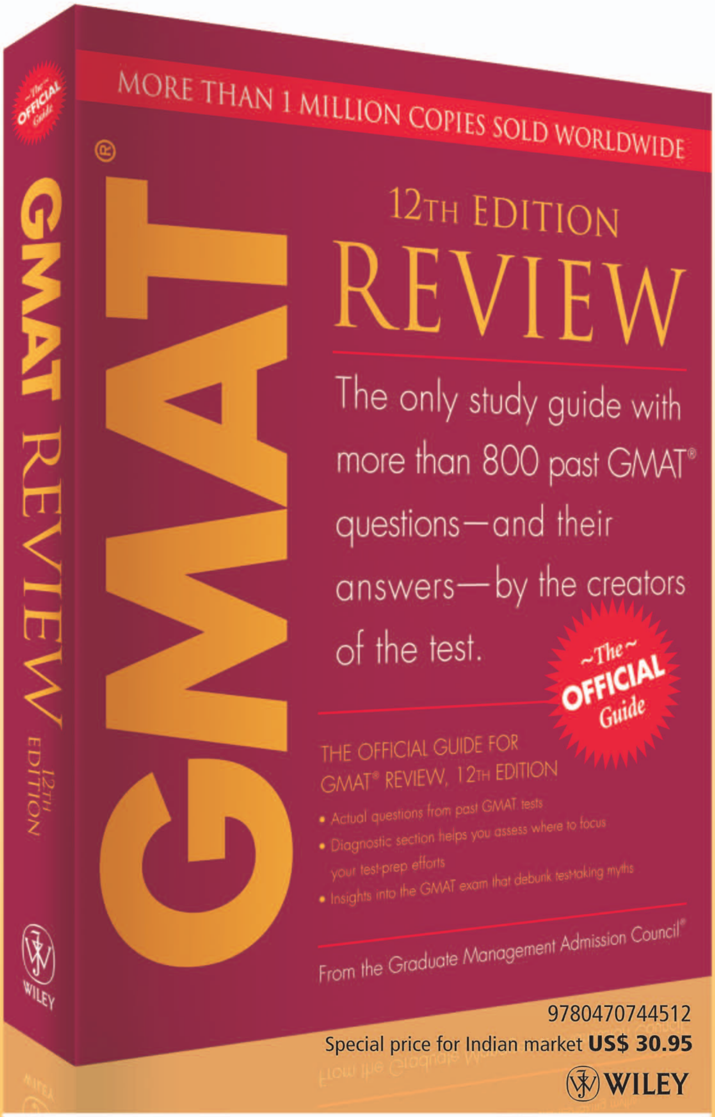
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VIRTUALISATION

Rahul loves star-gazing; it is one of his favourite pastimes. As a child, he would always hear stories about UFOs from his cousins in the US. Back then he would try and steal as much time on his rooftop as he could, trying to spot something, anything, unusual. After a while the UFOs lost their charm but the possibility of life beyond earth still fascinates him. At seventeen, he can finally do something about it. He discovered the SETI@home project, which employs virtualisation to process the data drawn from scanning the skies for aliens.

- ⦿ Why bother?
  The industry is extremely young and hence there are huge possibilities of growth as more than 90% of firms are yet to be virtualise their storage or servers.
- ⦿ How do I progress faster in this profession?
  If you are good at computers, analytics and programming, you will fit right in and since it is knowledge-intensive industry, constant learning is important.
- ⦿ Where am I ten years from now?
  Domain expert in virtualisation, heading your own team of processing engineers.
- ⦿ What's in it for me?
  While one enters the industry at a relatively good package of Rs. 6-8 lakhs, it can also go upto Rs. 30-35 lakhs in 7 years time. In terms of power , the industry is quite flat though one can switch to the managerial side after 10 years or so.

What is it?

Rahul's joined the online project SETI@home — a part of the project SERENDIP started by the Search for Extraterrestrial Intelligence or SETI institute. He downloaded the SETI@home software. Like every other computer, his computer also carries a lot of unused processing cycles. So, whenever he is not working on his computer, he leaves it on for the software to make use of that idle time. The software downloads a 300 kB chunk of data that comes from the Arecibo Radio Telescope, in Puerto Rico. Different packets of data are sent to the thousands of computers which have downloaded the SETI software for similar analysis. The results of the analysis from all these computers are ultimately sent back to the SERENDIP team and used to help in the search for extraterrestrial signals. In this way, a 2.5 MHz band of the observed spectrum is processed in the SETI@home project, across the world, and then finally comes back to the one nodal point. The process — grid computing — is one of the many ways in which virtualisation is all set to revolutionise our world.

A NASSCOM report refers to virtualisation as the next 'disruptive' technology (the previous one being the internet). Much like the internet, it has the capacity to change the way organisations work. By creating virtual space for data storage and maximising server capacities, it allows companies to reduce storage and power costs drastically. Data sharing becomes more simple as all servers are inter-connected. Hence, problems that would require access to large amounts of data, or a large number of processing cycles, can be solved much faster. This improved efficiency gives companies a huge gain in power, speed and collaboration.

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Why is it needed?

At the industry level, there are two kinds of virtualisations that are in use commercially — storage virtualisation and server virtualisation. While the former helps to expand the storage capacities of companies through virtualising and hence expanding storage space, server virtualisation helps in implementing out that storage in the least server space possible. Both of them use complex methods to attain these objectives and both help in cutting down companies cost substantially.

There's another buzz word in the virtualisation industry – cloud computing. IBM, Amazon, Google, Microsoft, Yahoo and more recently, AT&T, have already entered this race to the clouds. The technology helps save information at a distant server owned by the 'cloud-provider'. The biggest worry for the clients though is the reliability of storing data at a distant server and also the security of that data. While the technology is expected to be a big part of the future, currently it might have to cross a few bridges.

Currently only 4-5 per cent of servers in Indian industry have been virtualised, leaving more than 90 per cent of the market untapped. Companies are aware of the importance of the technology and hence the industry is bound to grow.

The Growth Story

According to an IDC report, virtualisation will rise dramatically by 2010. The report states that "More than 1.7 million servers will be shipped for virtualisation activities, resulting in 7.9 million logical servers. This will represent 14.6 per cent of all physical servers in 2010, compared with just 4.5 per cent of server shipments in 2005."

Gartner projects the global market size for virtualisation to be close to $19.2 billion by 2010. Grid computing is another aspect which Gartner thinks can be a great opportunity for Indian IT.

Currently, the big players in the in server virtualisation market are VMware and Microsoft, while NetApp and EMC in storage virtualisation. Quite notably, all Fortune 100 companies use VMware software solutions. This is one industry that insiders say has not been hit by the recession. Rather, the recession is leading to more work being off-shored to India in this industry — perhaps one of the very few industries that can say so in these times.

One usually enters the industry on a particular platform, i.e. Linux, Windows or Unix.

Based on these platforms comes the need for developers in these specific fields. The developers can then again be classified as kernel developers and application developers.

Kernel developers work on the basic operating system (OS) modules. The application developers work on the user mode and user interface.

At the other end are engineers who are required for testing the software and hence the term 'testing engineers'. The testing engineers are also divided on the basis of the OS platforms. In turn, the testing engineers have their own verticals of growth — test engineers, automation engineers, test architects etc.

Face-2-Face with practitioner

"Storage virtualisation basically involves expanding storage space for data storage through adding servers. While it might sound simple, earlier what would happen is that when someone had to expand the capacity of servers they had to replace the entire server. Though now with the help of virtualisation we can simply connect one server to another without disrupting anyone's work schedule. It is truly an interesting field to work in."

Divya Jain
Software Engineer
Brocade Communications Ltd

From the practitioner

27-year old Divya Jain works as a software engineer with Brocade Communications Ltd. A software engineer from Pune University, he has been in the field of storage virtualisation for over four years now — a field that requires constant innovation to merge and create space.

It a coincidence that he landed in this field. Jain says, "When I started out, I was working in the product area and I had to deal with core systems in Linux. The reason why I could enter this field is quite simply because I had studied computer sciences in my college. My very first firm was AMDOCS."

Sometime in the middle of last year, in the immediate aftermath of the financial market crisis, his current company had laid off a few people. However now, when the US is caught in a full-blown recession, his industry is seeing more off-shore work coming in as the low-cost factor continues to play out.

Since the field is new, the technology is still being understood. The work is complicated and requires constant knowledge improvement. Jain says, "We have to constantly upgrade our knowledge. It's part of our job to carry out external reading. Everyday we spend close to 20 per cent of our work time on online forums and e-books. It takes a long time, about 4-6 years, to become specialised in this field."

However, that doesn't mean a slow growth in salary or promotions. Jain says, "For two years you remain at the base level, as a junior engineer. While the salary differs from company to company, usually one starts at Rs. 3–4 lakh per annum. In four years, you reach the mid-level and in eight years one can become a Senior Developer. Even though there is a difference in designations, the industry is quite flat. There are fewer managers than in other industries."

He thinks it is a good industry for those who want to keep learning about technology and earn good money. What reassures him about the industry is the fact that there are so many big firms who are there in the field and they are continuing to invest. The number of clients is increasing and hence he is hopeful. He adds, "The added bonus is that the job doesn't really ever get monotonous. At least until now it hasn't. Maybe if you stick to a particular product line, then it can get boring. Then again, you wouldn't learn more about a product line until you are in it for a while. Hence what is required to stick to this industry is a strong grounding in programming, algorithms, a willingness to learn and patience."

From the employer

Gaurav Makkar works as a Senior Engineer at NetApp, one of the market leaders in the server virtualisation business. His function involves working as a researcher and a network architect in the firm. Even though he has been in the technology sector for over 14 years now, he has only been around in the field of virtualisation for less than two years, almost as old as the industry itself.

So what can one do to be part of this industry, which is going to completely alter the way we look at storing our data? Makkar says, "There is no buzzword at the entry level. We just look for a sound educational background. One should be good at computers, analytics and programming. A good software engineer will do. We largely pick up freshers as there are very few industries that build the kind of skills we are looking for."

But apart from this, Makkar says that after a while the industry does look at specialisations, "For example, a program developer must be good at MS architecture or OS architecture. Then we do need core developers and engineers and for every 10 core engineers, we also need 100 application engineers."

One of the greatest strengths of this industry, he thinks, is its relatively flat nature. "When you start out in this industry, you join as a member of technical staff (MTS) and your interaction with your seniors in the firm is not based on hierarchy. Rather, even today, my role is not to lead a team. I am a senior engineer, but my role is that of an individual architect and researcher. It gives me the space to work better without thinking about the politics around work. There are managers who are on a different vertical. So while our job is to provide the server solutions, it is the manager's job to see to it that the implementation is done efficiently." For those who want to join the management, there is that option too. Once one crosses the level of a senior manager, the choice is offered.

Face-2-Face with Employer

"It is still early days. Very few people actually know about this phenomenon, even though it can be a huge cost-saver. While virtualising, sometimes we found firms where some servers were not even being used to 10 per cent of their capacity. There are just so many improvements that are possible in so many firms. ""

Gaurav Makkar
Senior Engineer
NetApp

What are the required skills?

Makkar feels that to grow in this industry one needs to build on problem-solving skills. He says, "One should know how to get one's job done. How should I aim at this problem to solve it? How to convey the idea in the best possible manner to the person I am working with? And yes constant learning never hurts as this is a new field."

He sees the industry becoming more specialised by the day — as demand for specific kinds of virtualisations increase, hence the need for domain experts. "Domain experts have such great value in the US market. That is going to happen here as well. If one keeps moving from one field to another, one can never attain specialisation. Even within the organisation, you move in a vertical. The good thing is young people today show an aptitude that might help them in moving in that direction. Freshers these days aren't naïve. They like applied research and want industry oriented research. They are focused."

And for those keen on starting their own firm, Kakkar is definitely hopeful. "There are of course the big guns like NetApp, EMC, VMWare and Microsoft – but even today there is space for small start-ups to fill the gaps. There are smaller firms that offer adapters for virtualisation. But expanding would be a problem as infrastructure troubles would always bother them.

Compensation

Entry Level	6-8 lakh
10-20 years	25-50 lakh

Sample of a job description

We are currently looking for an architect (SAN or NAS Virtualization) to be based at Bangalore with the following skills:

- Individual will have a Masters Degree in technology with 12 - 18 years of IT development experience, with incursions into architect typical roles.
- SMust have in-depth experience and knowledge in storage software (preferable), UI, applications (e.g. SQL, Exch).
- SMust have strong experience in Windows, architecting (Win32/ 64, SDK) complex software products.
- SMust have broad understanding of upcoming and current technologies, such as virtualisation, cloud computing, SaaS and in areas of storage, networking and telecom.

Desired Candidate Profile

- Must have demonstrated experience in creating POCs for solutions (integrating existing products for field solutions) and future direction (integrating new technologies into roadmaps).
- Must have demonstrated in-depth experience in Windows for any of the following areas: system programming, web based programming, database/application programming.
- Highly skilled in C, C++, C# and working knowledge in Python, Java and .Net
- Must have evidence of artifacts such as patents, whitepapers, blogs and articles on technology.
- Must have some participation in industry forums, such as IEEE, SNIA, etc.

Senior/Lead Linux Kernel Engineer

Sample Job Description

We are looking for a virtualisation/senior Linux kernel engineer, with at least four years of experience:

- Ability to port the Linux kernel to a new CPU architecture
- Expert in virtualisation technologies such as Xen, L4 or UML is a plus
- Ability to design, architect, develop on Linux kernel internals such as file system code, memory management, scheduler.
- Expert C programmer
- Experience in one CPU architecture and its virtual memory concepts
- Experience in one of the assembly languages such as Intel, ARM, MIPS, PowerPC or similar.
- Ability to use open source software development tools such as git, gcc cross-compiler toolchains
- Experience in embedded systems.
- Experience in SMP and concurrency.
- Fluency in English

Responsibilities:

- This is an exciting hands-on work experience, since you are going to be developing on the core subsystems of an OS kernel and virtualisation software. Since the software is open, your name will take its place as one of the core developers.
- You will be asked to help in porting Linux to a new architecture, write low-level file system code, work on enhancing memory management software, the scheduler, paging, contribute in modifying kernel configuration and build system documentation and testing.

Mid career switch

The flexibility to switch from this field lowers as you spend more time in the industry. "It's best to switch at the beginning, as after that one becomes more specialised and more suited to this industry's needs than anywhere else. Though it is possible to switch within the server, storage and network virtualisation industries." Divya says. However, what happens in case one wants to change one's career mid-way after being a part of virtualisation for a good 5-6 years? Makkar says a switch within the industry is possible, but beyond this it can be a little difficult.

Major employers in India

EMC (VM ware)
Microsoft
Cisco Systems (India)
NetApp
ObjectWin Technology, Inc
Yahoo India

Resources for further reading

- http://www.virtualization.info/predictions/
- http://www.expresscomputeronline.com/20040524/technology01.shtml
- http://www.info4security.com/story.asp?storyCode=4122239&sectioncode=50
- http://www.cio-weblog.com/50226711/nasscom_on_chinas_it_software_services_industry_evolution.php
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- http://www.nasscom.in/upload/52333/Knowledge%20Services%20from%20Rural%20Centers.pdf
- http://www.nasscom.in/Nasscom/templates/NormalPage.aspx?id=5000

As far as Divya is concerned, he doesn't see himself moving out of the industry any time soon. He reasons, "The industry has just started out. India is moving up the technology ladder and more than a back-end place, it is becoming a hub for development. There are newer sectors such as network virtualisation where you virtualise over network capabilities. One basically decouples the network from the server. It is still in a nascent phase and much like the rest of the industry, even that will grow. "

The potential risks of being a part of this industry is that it can make you too specialised. So one has to gauge in the initial years if one is suited for this industry or not. If one were to get in a particular product line, the job can also become monotonous. Though the advantage is that after 10-12 years one can become a domain expert. Otherwise the industry does offer managerial roles but only after 4-5 years of experience within the industry.

Educational/training institutions

Makkar says, "There are of course the top most colleges such as the IIT and the IISc Bangalore; the students we like to pick up are largely from electronics or computer science background colleges, such as BITS Pilani, BHU, the NITs are also good."

As for colleges that offer good courses in computer sciences, he thinks well of his alma-mater, Pune University. However, the top-notch colleges like the IITs and the NITs do stand out.

- Indian Institute of Technology, Kanpur has a special course on Grid Computing
- Institute of Hardware & Information Technology (Enterprise networking), Amritsar

In most cases a basic degree in software engineering and networking helps. In most computer science courses, these aspects are part of the syllabus.

IT Infrastructure

When Viresh Gupta, the Head of Data Centre Operations, J&K Bank, received a call from the bank's Mumbai Disaster Recovery Site to say that it had stopped replicating data from the production site, he knew this had to be addressed immediately. This should be a serious alarm bell for any bank. Typically, banks store all information at the Production (Data) Centre. In addition, all back-up is taken at the Data Recovery Centre, which is usually located at a different city, so that in case anything happens to the main site, on account of technical failure or natural calamity, operations can run in a seamless manner.

- Why bother?
  The outsourcing infrastructure market could be as big as $111 billion, and is virtually untapped
- How do I progress faster in this profession?
  Continuous learner, problem-solving aptitude, leadership ability
- Where am I ten years from now?
  Senior Manager
- What's in it for me?
  Play a crucial role in the running of the company

What is it?

Viresh Gupta immediately flew with his team to the Mumbai facility and after 48 hours of non-stop work was able to get the Disaster Recovery Site up and running. Fortunately, no problems emerged at the main production site during this period, enabling the bank and its customers to conduct business as usual. It was on this day that the role of the data centre's team became very clear. Its role lies at the core of almost every organisation. The data centre is a part of the umbrella term "IT Infrastructure". IT infrastructure management services involve monitoring and managing a company's IT backbone — that broadly comprises the data centre, IT network, other IT applications and technical help support.

The data centre, also sometimes called a server farm, is a facility used to house computer systems (mostly servers) and associated components, such as telecommunications and storage systems, to run the applications which handle the core business and operational data of the organisation. The role of the data centre manager is to ensure the smooth running of the data centre and its applications.

Then there is the IT network, that consists of the networking components such as the routers, switches, leased line, internet connection, etc., that takes information from the data centre to the end users and back. The IT network manager has to monitor links, ensure they are optimally utilised and also undertake the design of the network.

The technical help consists of people whom we always call when there is something wrong with our desktop or our internet connection or any other computer-related problem.

An organisation can decide to manage its IT infrastructure in the following manner:

- Manage it in-house. This is how it happened traditionally. However, over time, as IT infrastructure has become large and complex, firms have been open to using specialised players to manage it.
- Outsource all or part of its IT infrastructure. For example, a company would be more willing to outsource the technical help desk than its data centre.
- Within outsourcing, a firm might choose a vendor that manages it on an 'onshore' model (i.e. client locations) or an offshore remote model or a mix of both. For example, Pronto Networks specialises in the deployment and management support of the wireless internet services infrastructure network of its clients worldwide.

Why is it needed?

IT operations are a crucial aspect of most organisational operations. The need for faster access to information, demanding customers, etc., have made firms invest in bigger and better IT networks which allow better access to data, customer response, reduced uptime, security, and so on.

One of the main concerns is business continuity; companies rely on their information systems to run their operations. If a system becomes unavailable, company operations may be impaired or stopped completely. It is necessary to provide a reliable infrastructure for IT operations in order to minimize any chance of disruption.

For these reasons, firms will want to have the best IT infrastructure in place to keep their competitive edge. It is this reason which is leading to

Face-2-Face with practitioner

"My role in the company is to manage the data centre of the bank where all the important information resides, ensuring proper backup and retrieving information in case of any failure"

Viresh Gupta
Data Centre Head
J&K Bank

bigger and better IT infrastructure for companies and job opportunities. At the same time firms are looking for specialists to come and ensure trouble-free working of their infrastructure.

Drivers of growth

In addition, there are different factors that are driving the growth of the outsourced IT infrastructure industry. First, it could be either the lower cost or specialised domain knowledge of such firms. Secondly, IT firms in this field also give the option to companies to take their assets (IT infrastructure) on their own books. Fourth, greater focus: when Bharti signed a $750 million deal with IBM in 2004, involving its data centre management, end-user support, help desk activities and network management, the rationale given by the company chairman, Sunil Mittal, was that his company would be better off focusing its time, management and efforts on processes that directly improve shareholder value. The successful execution of the deal, evident from further deals Bharti has undertaken for outsourcing infrastructure, have made other companies take notice of the benefits of IT outsourcing. Other Indian telco-operators have also begun to outsource parts of their business, such as call centre operations, application-based services and content.

On the supply side, global IT firms, such as EDC and IBM, were quick to realise the potential of this opportunity, and started offering it as a specialised service with the proposition of lower cost and domain knowledge to firms; this lead to growth of outsourcing IT infrastructure management.

Indian IT firms are also realising the potential of this sector and are developing their capabilities based on low-cost proposition and competing with the global players.

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According to Forrester Research, the outsource infrastructure market could be as big as $111 billion compared to an estimated of $120 billion for IT services and it is virtually untapped.

As Indian firms have built a reputation in delivering IT services in an offshore model, companies are more open to the idea of outsourcing infrastructure management to Indian firms. Indian firms are able to offer an attractive low-cost proposition to these firms. Add to this the fact that India has a large pool of cheap workforce — willing to work in the 'back-office' environment — with neutral accent and high understanding of technology.

Face-2-Face with employer

“This career is exciting because of the growth opportunities it offers, the international exposure and the continuous focus on training”

Mr Vaidthya
Pronto Networks

What are the related paths in this career that you can pursue?

Depending upon the whether one joins the IT operations of a company or a specialised outsourcing company, the career paths would vary:

In the case of IT operations of a company, one could join in any one of the areas:

- Data centre management
- Network management
- Other IT applications
- Technical help desk support

Within these technical roles, over time, the role quickly evolves to things like undertaking managerial responsibilities and evaluating various investment decisions.

In the case of specialised outsourcing companies, one could gain exposure across industries as well in addition to client development responsibilities, as one moves to senior roles.

Depending upon company policies, one can find the opportunity to move across different areas.

Why should you choose this career?

Viresh Gupta, Data Centre Head, JnK Bank says, "I was fresh out of engineering college and joined the bank after clearing an entrance exam. At that time, the bank did not have the concept of centralised data management. However, as the branch network spread, we realized that we couldn’t manage the workload in a decentralised system. A decision was then taken to move towards a superior, centralised system. As I had been working with the bank for over 15 years, I was given the opportunity to be part of the team to manage the new centralised data centre. The new set-up has greatly improved the efficiency of the bank."

What are the required skill sets?

One doesn’t necessarily have to be from an engineering background to get into this field. In addition, a number of certifications are being offered in the market (CDCP, CMM, CISCO certification, etc.) which are also added qualifications.

- **Continuous learner:** technology in this space is evolving rapidly. One needs to regularly keep oneself abreast of developments.
- **Problem-solving aptitude:** to be able to ensure that system runs smoothly 24x7, one continuously needs to anticipate problem areas and try to solve them proactively.
- **Leadership ability:** executives grow into leadership roles quickly. They need to keep their teams motivated and ensure their development in a fast changing technological environment

What makes people successful in this career?

☐ Aptitude for problem solving

A typical day would involve various problems to be resolved to ensure smooth functioning of centre/network. Emphasis is on ensuring process efficiency

☐ Ability to take initiative

From the beginning, team members are encouraged to give inputs for process improvements and see them getting implemented.

Major employers in India

These companies hire people on a regular basis and have operations in multiple cities

ABN Amro (ACES)
ACS of India
Encore Capital Group
Wipro
Cognizant
Convergys
Infosys
IBM
Dell
HP

❑ **Strong customer handling skills**

Handling customer escalations effectively requires more than just technical knowledge. The ability to really listen to and understand customer problems, being patient and having clarity in communication are required

Handling customer escalations, effectively dealing with cross-cultural customers/teams require strong inter-communication skills

❑ **Adaptability**

JnK Bank has a start-up culture – employees are expected to express their opinions freely to their mangers and participate in decision making which then happens more quickly. Employees are also encouraged to move across roles to gain a wider exposure

Growth Chart

Team Member (Tier 1, Tier 2, Tier 3) –> Team Leader –> Manager –> Senior Manager

In addition, employees are encouraged to move freely between different functions which could be Server Operations, Network operations, Product support executives, quality control section and product development.

Income Brackets

Domestic		
Entry level	0-1 year	Rs 1 to 1.5 Lakhs
Mid level	4 years	Rs 4 to 6 Lakhs
Senior level	8 years	Rs 8 to 12 Lakhs
Foreign		
Entry level	0-1 year	Rs 1.5 to 2 Lakhs
Mid level	4 years:	Rs 7.5 to 8 Lakhs
Senior level	8 years	Rs 12 to 16 Lakhs

What are the risks of choosing this career?

The industry is becoming increasingly competitive, with the need for improvement in operational efficiency, year after year. The need for performing a process efficiently and effectively is the foremost concern for the managers. This career is for someone who is always up to this challenge.

Sample Job Description

- To maintain the Network Operations within respective responsibilities realm
- Provide network continuity and innovation in supporting relevant lines of business
- Manage escalations where appropriate
- Ensure issue resolution by taking ownership on all issues receive as First Contact

Key result areas

- Plan and execute a network strategy that is in conformity with the short and long term network planning

- Ensure that requirements and priorities are properly defined and are in line with business needs

- Prepare personal MBO's in alignment with team MBO guidelines
- Evaluate new and emerging technologies
- Implement, analyze and operate network plans
- Monitor systems ensure to devices are meeting expectations and report findings
- Take ownership of First Contact issues
- Provide technical direction to the junior staff to ensure that standards and procedures are followed
- Interact and cooperate with other internal support groups to facilitate resolution of user problems

Knowledge, Skills and Experience

- Good oral and written communication skills, ability to articulate network issues
- Able to work individually and as a team member
- Strong troubleshooting skills
- Training and experience in networking protocols
- Knowledge of network standards and practices
- Knowledge and understanding of technologies in his realm of operation
- Experience in dealing with users
- College degree or equivalent experience
- 3+ years of network experience

Resources for further reading

- http://tinyurl.com/qdes9a
- http://snipurl.com/inu87
- http://snipurl.com/inu9j
- http://snipurl.com/inuap

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Embedded Design

Like most youngsters, Sumit is fond of cell-phones. He has changed three handsets in the past year alone. Though to him, it is not just about flaunting the gadget. His curiosity takes him beneath the screen, into the mechanics of it — into the software design. The software that finally decides what kind of functions his phone has. Someday he would like to design a phone that can club the functions of all his favourite handsets. This is one of the many jobs of embedded design. From your laptop to the gaming console to the microwave in the kitchen, nearly every piece of electronic equipment has embedded technology running it.

◉ Why bother?

It's a sunrise sector and India is becoming the hub for Embedded Design.

◉ How do I progress faster in this profession?

One needs to be a sound electronic and communications engineer and after the industry training, what helps one is one's own eagerness to learn more about the technology and apply it as well. An advanced VLSI (Very Large Scale Integration) certification can help.

◉ Where am I ten years from now?

Possible to be Project manager / Team Leader with a team of engineers working under oneself. The design of the chip produced by the team becomes your responsibility.

◉ What's in it for me?

Most firms have two growth ladders – one is the management ladder, the other is the technology ladder. The remuneration growth is similar until the level of the Vice-President. One usually enters the industry at Rs 4-5 lakhs. In seven years' time it can grow to upto 14 lakhs

What is it?

While it all starts with a new chip and the software in it, embedded design does not end there. Rather the production of a chip is just the beginning of innovations. The same chip can be used on different circuit-boards to produce everything from a piece of medical equipment, a highly sophisticated weapon to the very homely set-top box!

To assemble such a fundamental component of our daily lives requires fascinating and complex tools, namely, electronic design automation (EDA) tools. If slicing, analysing and understanding technology gives you a kick, then breaking down an EDA tool or rather putting one together can be a love story by itself.

Key drivers of growth

Embedded design is all about designing new software and putting together the hardware to execute it all. The field is wide and grew by 30 per cent on a year-on-year basis in 2006-07 — from $4.6 billion (Rs. 240 billion) to $6 billion (Rs. 184 billion). Embedded software contributed $4.9 billion (Rs. 196 billion) and employed 106,000 engineers, accounting for 82 per cent of the total embedded design services workforce, according to an industry report.

Why is it needed?

Recession has taken its toll on this industry. As the sales of home appliances dropped, so did the demand for the chips inside them. The industry believes that a recovery looks likely only by mid-2010. While there will be a fresh demand for already-existing electronic goods, there is a next generation of chips that is already on the table. Chips of the future will help us improve the efficiency of generating electricity more effectively from sunlight, water currents and any other renewable energy source. Medical equipment to mobile phone gaming, all of these will improve. And chips that might just extend the science of motion-gaming to a whole new array of products.

Earlier, and to a large extent even today, companies like Intel and Texas Instruments, two of the largest employers in the sector, would get the design for a product from Europe or the US. India would just be the ground for design execution or software development. But as the Indian market grows in size and importance, products are being designed especially for the Indian consumer.

One of the more common examples being the set-top box: What started with one state, i.e. Tamil Nadu's experiment with the cable network, has now spread out to be an entire market in itself. Tata was the first entrant followed by Reliance, Airtel and Sun Direct. At the time of its launch, India did not have the capacity either to design or manufacture the integrated circuits (ICs) required in the set top boxes (STB). Import was the only route. But as more market players entered the fray, the demand for a home-grown product increased. Government also did its bit by offering incentives to chip manufacturers. The result — the STM 5107 from ST Microelectronics, a geode processor from National Semiconductor and Broadcom's system-on-a-chip (SoC) solution — all these chips developed right here at the Indian Design Centres and already in use by various set-top box providers. Market researcher Instat says that by 2012, India's pay-TV market is expected to reach 90 million subscribers. It estimates upwards of $1.0 billion worth of market for STB ICs by the year 2012.

Any of the above-mentioned chip manufacturers provide their buyers with a chip that differentiates the ultimate product from the other products in the market. Uniqueness is something we look for in any product we buy. Hence it becomes important for all electronic goods to provide something unique, something that is an improvement over the previous model and a characteristic that sets it apart from other products in the market. More often than not, the chip becomes that differentiator. And hence, the importance of the chip designer.

Three paths to choose

If you were to pursue a career in this field you could choose to be a part of three different industries:

- Chip design and development
- Embedded product design industry
- Electronic design automation tools

Currently over 82% per cent of embedded design engineers are employed in embedded software, followed by Chip Design and EDA at 18%.

What are the required skill sets?

Basic requirement is a degree in electronics communication engineering. During interviews, firms look for a good sense of engineering with a sound grounding in mathematics, physics and electronics. Knowledge of different languages is not a must.

A number of courses have come up in design which teach the tools (VHDL, EDA, etc.) and taking them would be a bonus.

Constant improvement of skills and knowledge is a must as the design tools and processes keep evolving.

What is the required mind set?

- **Ability to deal with a level of abstraction:** The science and craft of design is evolving and becoming more complex. Practitioners need to hone their skills over the years.
- **Get a kick out of technology:** Chips are at the root of a lot of product innovations that taking place. Given the amount of effort and time involved in seeing the final product, a person should inherently be in love with technology to keep him going.
- **Patience:** It takes over a year and a half before freshers can start contributing productively to various projects. So don't lose heart early on.

What are the future prospects?

Compared to other engineering fields, for example the mechanical industry, the chip industry is more cyclical in nature. If one is making a career decision, one shouldn't be swayed by the current outlook — the industry has always bounced back from recessionary periods with renewed avenues for growth.

Currently, the industry is looking at alternate energy and MEEMS (Micro Electronics Electromechanical), for example the Nintendo Wii, as the new growth areas.

Sumit Sharma is a 26 year old design engineer, currently working with Samsung India. He has been a part of the embedded design industry for the past four years now. He started his career with Infosys in the product engineering department, and after working for three years changed company to grow vertically. Here's what he had to say about his job.

Face-2-Face with practitioner

"There are constant innovations that are required and hence there is constant scope for growth. For example, when the iPhone was launched, other companies wanted to make phones that could provide even more functions than the iPhone and yet have an equally eye-catching interface"

Sumit Sharma
Design engineer
Samsung India

How would you describe your profession? Would you say that it is fairly representative of a career in embedded design?
Yes, it is definitely representative of product-based embedded design. I work with Samsung India and we basically work to improve the software available on the phone. Every six months we get a new project, a new aspect to be worked on, and that keeps me going. Similarly, there are other phone companies, core hardware, system design, electronics, medical equipment manufacturers that also work towards improving their software and have their product engineering departments. But every company has its own requirements and hence one goes through a training program to adapt to the needs of the particular company or industry.

What are other main types of paths/options for someone who wants to make a career in embedded design ?
Outside of product-based embedded design, there is of course the semiconductor industry which manufactures chips. They design chips for all kind of products and then we can build on those basic chips to differentiate our product.

The other career path one can take is in the even more specialised field of electronic design automation tools — the tools that are used to manufacture chips.

What drove your choice of this career? Please give a glimpse of your journey to the current position?
It was mostly a sum of coincidence and interest. I entered the technology industry as a software engineer with Infosys, and since I was a fresher I was open to options. The firm had a small production engineering development division. I joined it and began liking the product engineering work. But since Infosys is largely a services company, the product development did not have much growth and hence to grow in the product development vertical I moved to Samsung.

What are the kinds of skills required to enter this industry?
It helps if you have studied either electronic and communications engineering or computer sciences. It is good to have strong basics in computer sciences and then the training for the particular industry takes over. The training is taken care of by the firms that hire you.

In your view, how crucial are the following in influencing one's path/growth in this career – does it matter which college you are from?
It really doesn't matter. Once you are hired, it basically depends on your output after the industry training.
– How much does my performance in college matter? Again, to get in the best firm, one should be a good scorer .But beyond that it depends on your output in the job.
– Are there some other certifications that can help? Maybe an advanced VLSI (Very Large Scale Integration) certification can help. The Indian Institute of Sciences offers a number of short term courses in different aspects of embedded design.

What are the unique highs and lows in this career?
One has constantly to keep improving knowledge, and that's the real challenge. My projects keep changing and the maximum we are on a project is for 6-8

months. Since I have to constantly improve myself, everyday 20-30 per cent of my time is spent on learning new things. There's never any monotony.

Sometimes, to work on specific projects, one also goes outside the country. I have already been to Korea, Spain and the U.S.

What are your three or four attributes which you think have really helped you in this career? What advice would you give based on this to people?
The job requires constant learning and hence one has to be diligent, patient, and always eager to learn.

Are there things one could do to grow faster in this profession?
There's only one thing you can do — learn, learn and learn. There are no short cuts here. One usually starts as a project manager and then moves on to become a developer, may be in 6-7 years time a team leader and then in 10 years time you can become a project manager. One has to keep specialising in solving bottle necks in designing and the only thing that helps is learning and applying that learning. Hence, no shortcuts.

How easy is it to change careers after some time? Are there natural cross-roads? What are some usual transitions people make/can make?
The career choices that you can make, one gets to make right at the beginning. As a fresher you can choose to enter any of the embedded design industries. But then the software design of most products is very specific to that product. Maybe one can jump between companies if both of them make the same type of product, say cell phones, but beyond that one does not have much flexibility. Though there are opportunities to switch to the management side of the firm you are working in. On the technology side, one switch that is possible at a later stage is the switch from the chip design industry to the EDA tool industry. Otherwise it makes sense to become a domain expert.

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What future prospects do you see in this career? What are the emerging hot areas within this sector/profession?
There are constant product innovations that are required and hence there is constant scope for growth. For example, when the iPhone was launched, other companies wanted to make phones that could provide even more functions than the iPhone and yet have an equally eye-catching interface. Similarly for phones at the lower end, companies require a product differentiator and hence the growth in the sector is assured.

Compensation-

❍ Trainee - 3-4.5 lakh
❍ Mid-level - 8-14 lakh
❍ Project Manager - 16-20 lakh per annum

Please note: These figures do not represent the compensation package of any one company. It is an approximate based on discussions with experts across companies.

Rahul Hakhoo is one of those rare people who has been in the semiconductor business for nearly 25 years. He started

Face-2-Face with Employer

"As the industry specialises, the demand for domain experts is going to increase. Hence the pay for such people should also increase. So, engineers need not abandon their love for technology to earn more. One should focus in growing in the direction of expertise,"

Rahul Hakhoo
Designate Group Manager
Computer Communication
Infrastructure
ST Microelectronics

his career in 1985 as a test engineer with the then only Indian semiconductor firm, Semiconductors complex (est. 1982), Chandigarh. Today he is the designate group manager, computer communication infrastructure at ST Microelectronics, one of the leading semiconductor makers in the country. He gives you his perspective as a representative of an employer.

❑ What kind of professionals do you have/hire in this particular area:
- At entry level
- At middle level

We largely hire fresh graduates. It makes sense as we need professionals trained according to the needs of our industry. And hence to put them in sync with the industry we give them the initial training. No Indian institute specifically trains for semiconductors. That doesn't mean the institutes aren't good. Rather they train them to fit in any engineering environment. As far as we are concerned, we pick up largely electronic and communication engineers.

Since the industry is so specialised, it is extremely rare that we pick up anyone from outside the industry at the mid-level.

❑ What is a typical career path(s) in your organization?

Typically one is hired as a design engineer and then the person works and learns at this level for 2-3 years; after this, one can become a senior design engineer. The distinction being in terms of responsibility and of course pay. One can reach up to the level of a team leader after about 10 years.

❑ Are these career paths fairly representative? Are there any other major alternative paths in other kind of organizations?

The whole industry is a knowledge-intensive industry. Hence the career path is pretty much the same in the entire industry. No one moves up without learning and executing substantially. Though after 4-5 years, when someone does learn the craft of chip-making, one can switch to the EDA tool-making industry. Making an EDA tool is even more specialised than chip making as they have to make very precise instruments. These instruments are in turn used to make chips. Hence it helps to have people who have made chips on-board.

❑ How does compensation and responsibility typically grow over time?

We design chips for a number of industries, such as auto, telecom, medicine, and for each of the chips that are underway, there are various teams working on them. The design engineer is a small but significant part of several such small teams. Overtime, he gains more responsibility within such teams and in 9-10 years time he leads his own team of design engineers. At that level you have 6-7 designers under you and your salary has gone up from 4-5 lakh at the beginning to 15-16 lakh.

❑ What kind of skills and aptitude do you look for / consider important to succeed in this career?

The engineer should basically understand semiconductors and should have a good understanding of physics, mathematics and electronics. The knowledge of computer languages is not really stressed. Apart from this, the professional should be willing to learn constantly, as learning and its application will be tested constantly.

☐ How do you see the future potential for professionals in this area? What are the main drivers that determine how this sector/profession grows? Are you expecting some major shifts/changes, challenges and developments?

Currently, the industry has been hit by the recession quite badly. In my 25 years experience I have seen 8 or 9 downturns but this has been the worst. Though as things turn around, the industry will see growth once again.

There are a lot of technological bottlenecks that currently exist — bottlenecks that can be addressed through new and innovative chip designs. The two fields of research and application that are specially going to lead the boom are motion-sensing (MEMS) technologies and green technologies. While motion sensing will most likely produce better bio-medical equipments, efforts are on to produce chips that will help generate electricity more efficiently from renewable energy sources.

☐ Are there things one could do to progress and grow faster in this profession?

That's a huge problem amongst youngsters these days. All they want to do is to grow fast. Until recently when the economy was doing well, the attrition rate was extremely high. So many people would keep jumping from one semiconductor firm to another. Money was a huge draw. Right now, every one is lying low.

In our company we have two growth ladders — one is called the technology ladder, the other the managerial ladder. Almost everyone wants to jump to the managerial ladder as they want to grow to take control. But they forget that the future in this industry lies in understanding a particular technology and then becoming a domain expert. With time, as the industry specialises, the demand for domain experts is going to increase. Hence the pay for such people would increase too. So engineers need not abandon their love for technology to earn more. One should focus in growing in the direction of expertise.

☐ But if it is all about specialisation, then how easy is it to change careers after some time? Are there natural cross-roads? What are some usual transitions people make/can make?

The only natural cross road I can think of is that of switching from the chip design industry to the EDA tool industry. Apart from that, it is an industry for those that are interested in applied research. People who are patient and diligent and want constantly to be on the cutting edge of technology. As I said earlier, they can become domain experts after spending a long time, and the industry needs such people.

☐ Are there some institutions/ universities/ courses where you have generally found better candidates for your company?

Well, we do go to the IITs and the NITs to pick up the electronic and communication engineers. Apart from that, there are also some good private engineering colleges that give out good students.

Risks

One of the major risks in this career is the fact that it can be a little too specialised. If one wants to switch to some other industry, this can be difficult. In the first few years one can get to know if one is suited for the industry or

Major employers in India

Texas Instruments
Intel
ST Microelectronics
Samsung India
Sony Ericsson
Nokia
Cadence
Synopsis
Mentor Graphics

not. That is the right time to make a jump, before specialisation sets in and hence one's skill remains suited to the particular industry.

Schools/certifications to consider:

- Centre for Electronics Design and Technology
  Indian Institute of Sciences
  Bangalore
  25 courses in different aspects of Embedded Design

- Visvesvaraya National Institute of Technology
  Nagpur
  Master of Technology (MTech)
  Electronic Embedded System (Two Year Course)

- Sastra University
  Tirumalaisamudram, Thanjavur, Tamil Nadu
  M.E. Embedded Systems Technology (Two Year Course)

- Anna University
  Chennai
  M.E. Embedded Systems Technologies

- Indian Institute of Technology
  Delhi
  Certificate course on embedded systems and applications in telecom and multimedia (one- month course for engineering graduates)

- Centre for Development of Advanced Computing
  Hyderabad
  Full-time diploma in embedded systems design (Five- month course for Engineering Graduates in Specific Fields)

Please note: This list is not exhaustive and is compiled based on discussions of experts across industries

Resources for further reading

- http://tinyurl.com/raoh8e
- http://www.embeddedtechmag.com/
- http://www.cse.iitd.ernet.in/esproject/
- http://www.embeddedtechjournal.com/index.htm

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Chip design

Chip design as a career option? Yes, we are talking about building the hearts of almost all the devices that surround us. In IT-parlance, the chip is the wafer-thin slice of silicon that forms the base for an integrated circuit. Producing it isn't all that simple. In fact, it is a highly complex task that can broadly be divided into three phases: design, fabrication and assembly. The return is to watch the world around you use your product to run its life.

⦿ Why bother?

Gartner estimates that the market will grow by 26 per cent in 2008, year-on-year. Between 2007 and 2012, we expect the third-party chip design services market in India to grow at a CAGR of about 22.3 per cent, to reach nearly $830 million by 2012.

⦿ How do I progress faster in this profession?

Constant improvement of skills and knowledge is a must as the design tools and processes keep evolving.

What is it?

The chip design phase involves detailing the physical circuit that can implement a particular application on a piece of silicon. The physical circuit would integrate billions of transistors to achieve an application that would suit a particular requirement, such as microprocessor, router or cell phone.

Fabrication involves creating the physical circuit on silicon, and is akin to manufacturing. Assembly involves wrapping the piece of silicon in a package so that it can be used in an electronic circuit.

The early stages of chip design saw the emergence of big players (Intel, AMD, et al.) that did everything on their own, from chip design to fabrication. The second phase saw the rise of Taiwanese stand-alone foundries which enabled the integrated companies to outsource their fabrication functions at a lower cost. This separated the capital-intensive fabrication phase from the people-intensive design phase and allowed countries such as India to get into chip design.

Currently, the key players in the semiconductor design industry can be segregated into:

- **Fabless firms:** These do only design work and don't undertake actual manufacture of chips
- **Design service firms:** Those who execute specific contracts for big firms in chip design
- **Silicon intellectual property firms:** These create IP and then sell it to other firms
- **EDA (Electronic Design Automation) tool vendors:** Those who evaluate designs for manufacturing readiness

Why is it needed?

The design and manufacture of faster and smaller semiconductors means that they can be used in different applications, thus driving growth of the industry. From being used in mainframe computers in 1970s to PCs in the 1980s to mobile handsets in the 1990s and in consumer electronics at present, the industry has always found a new driver for growth.

The ongoing recession has hit the electronics sector, which, in turn, has taken its toll on semiconductor sales — it is projected that the next generation of application growth will drive from as diverse fields as renewable energy, electric vehicles, healthcare, and so on.

As innovations take place, there will be a need for people who can innovate even further. That is also where specialised chip designers will be preferred over software engineers.

The growth story

India, with its abundant engineering talent and low costs, is an attractive destination, and hence will definitely be an important player in the chip design business.

- A recent ISA-IDC report found that the total chip design market is expected to surpass $7.37 billion in 2008, with a huge chunk of revenues coming from embedded software, followed by VLSI design and hardware/board design.
- Gartner states that the market for third-party chip design services in India is estimated at about $400 million. Ganesh Ramamoorthy, Principal Research Analyst, Gartner, says, "Gartner estimates that the market will grow by 26 per cent in 2008, year-on-year. Between 2007 and 2012, we

expect the third-party chip design services market in India to grow at a CAGR of about 22.3 per cent, to reach nearly $830 million by 2012."

- Over 125 companies are estimated to be India-involved in various aspects of design. There are the big multinationals such as IBM, Intel, Texas Instruments. Then there are the big Indian IT players like Wipro, Infosys and TCS, who have set up engineering design service practices and an ever growing number of entrepreneurial firms. All this makes India a hot destination for chip design and creating more job opportunities. The industry is estimated to employ over 1,00,000 people.

What are the related paths that you can pursue?

Chip design career can have the following flavours:

- SOC integration engineer
- IP developer: analogue or digital
- DST design engineer: focusing on testing
- Verification engineer: verify design in simulations

There are two separate cadres:

- **Technical cadre:** typically everybody starts on the technical side as individual contributors, i.e. design engineer, senior design engineer and moving up to division head.
- Over time, senior technical people can also assume part of the role of business development – in terms of understanding customers' needs and suggesting solutions.
- **Project manager cadre:** post 6-8 years of experience, designers can move into the project manager role involving management of project, integration and liaison.

Why choose this career?

Rahul Hakhoo, Head, Computer Peripheral Divisions, ST Microelectronics: It was a strange quirk of fate. While I was completing my engineering, one of my professors suggested I do an internship with a chip manufacturing company called Semiconductor Complex Ltd. As students, we had heard about chip design being the 'next big thing' and though I was quite at sea about it, I decided to join the unit. The internship led to a full-time job and within the first six months my supervisor asked me to shift to the design division of the company. There was so much to learn there that I ended up spending another six years in the design unit!

Face-2-Face with practitioner

" My role in the company is to guide and manage the chip design team that is doing a lot of interesting work in developing new chips that will enable new and better products in the computer peripheral industry,"

Rahul Hakhoo
Head, Computer Peripheral Divisions
ST Microelectronics

What are the required skill sets?

- Basic requirement is a degree in Electronics Communication Engineering. During interviews, firms look for a good sense of engineering with a sound grounding in mathematics, physics and electronics. Knowledge of different languages is not a must.
- A number of courses have come up in design which teach the tools (VHDL, EDA, etc.) and taking them would be a bonus.
- Constant improvement of skills and knowledge is a must as the design tools and processes keep evolving.

What are the future prospects?

Compared to other engineering fields, for example the mechanical industry, the chip industry is more cyclical in nature. If one is making a career decision,

Face-2-Face with Employer

"It's extremely satisfying to work on something and watch the world use it. For example, when I joined Intel 17 years ago we were working on the Pentium Pro. Today there are 200 million of them being used all over the world."

Rohit Vidwans
Director
Digital Enterprise Group
Intel

one shouldn't be swayed by the current outlook — the industry has always bounced back from recessionary periods with renewed avenues for growth.

Currently the industry is looking at alternative energy and MEEMS (Micro Electronics Electromechanical), as used in, for example the Nintendo Wii, as the new growth areas.

Over all there is great potential for chip design. There is a demand for chips in every sector, be it automobiles, consumer electronics or high-end servers. There is a constant need for more chips. Rohit says he doesn't see a problem for every engineer coming out of the engineering schools wants to make a career in chip design, in getting a job. Companies like Intel, IBM and Cisco have all set up operations in India and are always looking out for fresh talent.

Sample Job Description

Lead - WiFi

- Strong experience and expertise on 802.11 a/b/g protocols
- Should have worked on solutions around this technology
- Design and development experience with specific LLC and MAC layer protocols
- Complete understanding of the overall system, interactions among various modules and blocks in the system
- Familiarity with test frameworks for these protocols
- Working experience with standard body forums and communities
- Should be able to understand the wireless technology landscape, have understanding of current limitations and challenges
- Need to interact with clients in understanding the requirements and should be able to architect solutions

Lead - WiMAX

- Well versed with 802.16d/e technologies
- Development experience with MAC layer/data link layer
- Awareness to various WiMAX Network Interfaces, their Design and development nuances
- Interaction with WiMax forums an added advantage
- Understanding technologies for Multi-Service Networks, Mobility Management Procedures
- Complete understanding of the overall system, interactions among various modules/blocks in the system
- Familiarity with Test frameworks for these protocols
- Working experience with standard body forums and communities

Examples of Employers

Infotech
Intel
Cisco
GE
HCL
IBM

Required Mind Set

Ability to deal with a level of abstraction: the science and craft of design is evolving and becoming more complex. Practitioners need to hone their skills over the years.

Get a kick out of technology: chips are at the root of a lot of product innovations taking place. Given the amount of effort and time involved in getting to the final product, a person should inherently be in love with technology to keep him going.

Patience: it takes over a year and a half before freshers can start contributing productively to various projects. So don't lose heart too soon.

- Should be able to understand the wireless technology landscape, have understanding of current limitations and challenges
- Need to interact with clients in understanding the requirements and should be able to architect solutions

Some educational institutes to consider

- IITs
- NITs
- BITS, Pilani: Post-graduate course in microelectronics
- BIT, Mesra: Dept. of Electronics and Communication Engineering: Post-graduate course in instrumentation and control

Other institutes that offer courses in the VLSI domain:

- Bitmapper (Pune): Diploma in VLSI design
- CDAC Advanced Computing Training School: Diploma in VLSI
- V3Logic (Bangalore): Diploma in VLSI design
- Accel Ltd (Chennai): Post-graduate diploma in VLSI design
- Benns Technologies (Bangalore): Part-time / Full-time course in VLSI
- Calorex (Ahmedabad): Course in VLSI ASIC chip design
- Vedant (Chandigarh, Lucknow): Course in front-end and back-end design including Analogue & Mixed Signal design
- Sandeepani (Bangalore, Hyderabad): Post-graduate diploma in VLSI design, corporate training, workshop and seminars, and on-site customised training

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Resources for further reading

- http://www.financialexpress.com/news/engineering-a-talent-pool-in-chip-design/108987/
- http://www.tribuneindia.com/2006/20060419/jobs/main1.htm
- http://infotech.indiatimes.com/articleshow/msid-38796723,prtpage-1.cms
- http://www.thinkdigit.com/details.php?article_id=953
- http://www.chipdesignmag.com/

Telecom Engineering: Mobile Phone Network Infrastructure

A phone missing from your pocket feels like a missing wallet, or even the house keys. For some people it feels like a lobotomy. The thought of such a dependency on the mobile phone two decades ago would have been laughable. Not any more though. Today, telecommunication has become an indispensable part of our lives by making us far more efficient. A career in it is looking more attractive than ever before.

- ⦿ Why bother?
  Projected mobile penetration of 40% (500 million) by 2010, in India.
  Estimated 275,000 new jobs over next five years.
  Constant evolution of mobile technology over the next five years
- ⦿ How do I progress faster in this profession?
  Adaptability to the ever changing pace of the industry.
  Constant improvement of skills to keep up.
- ⦿ Where am I ten years from now?
  Technical Lead OR Senior Manager
- ⦿ What's in it for me?
  Continuous innovation.
  Marked use of your own technologies.

What is it?

As time goes by the amount of data that flies invisibly between our phones is increasing. In 1996 we saw the introduction of SMS and voice in India. Soon we had far richer data capabilities — multimedia and comfortable text surfing on the net. In the future, we're going to be seeing high-definition video fly in and out of devices the size of a handset. We're talking dozens of megabytes per second here. Theoretically UMB (Ultra Mobile Broadband) would allow you to handle 275 megabytes per second download and 75 MBps upload, even in a car travelling at 60 km per hour. When the Indian telecom industry started out about 14 years ago, we had to struggle with call-drops while standing still. There's still enormous scope for improvement. It's not just because of improving handsets. It's also because of what's happening at the network end.

However, Telecom Engineering is a lot larger than just mobile phones. This is just the most visible part as a consumer. This field is larger than telephones. It's about communications. The entire industry is dedicated to ensure that individuals, organisations and even continents can communicate more efficiently.

Broadly put, telecommunications is about the transfer of data. We however, are most familiar with that chunk of plastic and metal in our pockets. Beyond that we have networks, satellites and undersea cables.

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Why is it needed?

With the explosion of electronic media, telecommunication engineering/ infrastructure is one field that is gaining immense popularity as a lucrative career option for the new generation.

As you drive through the city you see huge towers everywhere. Each of these is busy beaming signals across its circle to ensure you can stay connected. There is a huge infrastructure that goes behind a telecom company. This includes the setting up of towers, laying of cables where necessary and then bringing the whole customer end together. Basically, a cell site consists of electronic (active) and non-electronic infrastructure (further defined below):

- Electronic infrastructure includes base tower station, microwave radio equipment, switches, antennae, transceivers for signal processing and transmission.
- Non-electronic infrastructure includes tower, shelter, air-conditioning equipment, diesel electric generator, battery, electrical supply, technical premises and easements and pylons that account for nearly 60 per cent of network roll-out costs.

Telecom is a mammoth industry and opens a wide range of career opportunities on both the hardware and software fronts. The list is long: mobile telephony, internet protocol media system, wireless communications, GSM (Global System for Mobile Communications), GPRS (General Packet Radio Service), CDMA (Code Division Multiple Access), VoIP (Voice over Internet Protocol), data networks, optical networks, and much more. Internet Service Providers use telecom hardware and therefore employ telecom engineers for their network-related operations.

The growth story

The teledensity was 34.5 per cent as in Jan 2009 and the projected teledensity is 500 million, 40 per cent of population by 2010. One can just imagine the number of people who will be required to service the demands of such a fast growing industry.

An estimated 275,000 jobs will be created in this sector over the next five years. Telecom, just like IT, is a growing industry because of the amount of innovation and growth it sees. It is an arm of technology that now plays a very fundamental part in our lives.

Reliance, Bharti Telecom, Tata Indicom, Hutch (Vodafone), MTNL and BPL are the major operators in India. Aircel has also stepped in as a major player.

There are many more, such as Unitech, Shyam and others, in the pipeline. Until recently, only the PSUs, BSNL and MTNL, were allowed to provide Basic Phone Service through copper wires in India. MTNL is operating in Delhi and Mumbai only and all other parts are covered by BSNL. However private operators have now entered the fray, although their focus is largely on the cellular business which is growing rapidly.

Career path and future prospects

People with a broad-level experience and understanding of the industry can also move into the software field. Once you understand the software or hardware side completely you can move into sales. Domain knowledge is a prerequisite to sell it. Hence, if you come from a sales background you cannot move into the software or hardware divisions.

The options for a fresh engineer are pretty open. The skills you possess determine the field that you choose. You could start from software for VAS, handsets and infrastructure and then switch between these mid-career.

Abhinav Goyal, a telecom software professional working for a telecom equipment manufacturer says that depending on the company employing them, people could be working for:

- **Independent Software Vendors (and services companies):** for example, Aricent
- **Hardware Vendors (and services companies):** for example, Flextronics
- **Telecom Equipment Manufacturers:** for example, Cisco
- **Network solution providers/integrators:** for example, GTL, IBM, Accenture (also an ISV)
- **Operators:** for example, Airtel, Vodafone
- **Network Operations and Management Companies:** for example, GTL, IBM

Future prospects

The career tracks are conventional and have a steady growth path. Besides the telecom companies, there are many research labs setting up in India which will require PhDs and MAs with hands-on knowledge of telecom. If you are interested in working on the next big thing then this could be your path.

Perhaps building the next slick handset appeals to you. If this is the case, then there is scope in new product development for APAC Markets as all handset manufacturers, except for the iPhone and Blackberry, are rolling out handsets here.

Traditionally, you could expect the following growth path in software or hardware roles:

Software/HW Engineer -> Senior software/HW engineer -> Assistant manager Software/HW -> Manager Software/HW

Hardware opportunities

Design and implementation: designing telecom systems equipment, infrastructure, and networks is a good career option since there has to be a proper design in place before installation of equipment such as switchers and routers at a base station. But design and manufacturing of original telecom equipment is yet to take off on a large scale in India. Equipment design engineers, therefore, see better prospects abroad.

❑ **Operations and maintenance:** the telecom infrastructure requires operational support and maintenance to function at optimal capacity. This domain includes monitoring, troubleshooting, and analysis of the operations which take place at the base service station. Ultimately, the job of those in the operation and maintenance department is to ensure that voice is transmitted from one end to another.

❑ **Services:** increased competition means telecom service providers must provide quality service keeping operational costs under control. They deploy solutions for service quality management, fault management, and performance management.

❑ **Network:** job functions in wired, wireless, and data networks all fall under the network umbrella. Employed in this domain are engineers who specialise in wireless and other technologies. They are, for example, GSM or CDMA engineers / specialists, GPRS engineers / specialists. Specifically, installation, planning, administration, security management, troubleshooting, and testing of networks are involved in this domain.

Freshers are usually absorbed into the industry in networking jobs. Network engineers at times design terrestrial networks and certify them. Vendor-specific certifications are a plus in a network engineer's profile. Of all the network functions, security is an area worthy of mention in terms of opportunities.

Software opportunities

Software in this industry usually enables signal testing and network monitoring. Real-time operating systems are of particular importance to aspirants.

Revenue and billing services: those skilled in DBA (Database Analysis) software systems and data warehousing are employed extensively in this sector. They specialise in working on vendor-based applications and software systems such as Oracle, Kenan, and Siebel. The professional here keeps a check on whether customers are correctly billed and prevents fraud or faulty billing.

Value-Added Services (VAS): a fiercely-growing domain, emerging as a separate industry, VAS includes entertainment, commerce, TV, and more — on the mobile. The majority of the opportunities in VAS are towards programming for the mobile platform.

Face-2-Face with Practitioner

"I specialise in delivering software for telecommunication products. A significant percentage of people in the telecommunication industry fall in this category..."

Abhinav Goyal
Senior Technical lead
Sonous Networks India

Facts and figures

Total telephony subscribers:
(Wireless and Landline) were 400.05 million (Jan 2009)
Cellphones: 362.3 million (Jan 2009)
Land Lines: 37.75 million (Jan 2009)
Broadband connection: 6.22 million (March 2009).

Face-2-Face with Employer

"You really have to redefine the technology of how the world communicates. It's not just about communication at the handset level. It could be two networks or even two continents talking to each other."

Indu Kapoor
HR business partner
Reseach and Development
Alcatel Lucent, NCR Region

Power of the tower!

Can you imagine yourself without a mobile phone? No, because telecom has become a lifeline for the world at large. The lifeline is supported by a tower, the base station, that stands tall in your city and ensures your connectivity at all times.

As more people buy cell phones for the first time, mobile service providers have to install more antennae and base service stations. In turn, the demand for those who specialise in telecom design and implementation is bound to rise.

Recently in India, many new telecom companies were awarded licenses to operate in various states across India. Some of them hold a Pan India License. The entry of so many players in telecom throws up many issues. How are these new players going to establish themselves? From where will they get people to operate? How will they scale at the pace they want?

Amongst the world economies, India has one of the fastest growing telecom networks with its high population and development potential. While over 380 million people own mobile phones in the country today, the number will shoot up to 500 million mobile users by 2010, as telecom operators will look to tap the unexploited rural market (source: Mobile Marketing Association (MMA)). This creates a huge need for professionals with relevant telecom backgrounds to support, service and meet the demands of the sector.

What drove your choice of this career?

Veer Chand Bothra, Revience: I got hooked to the internet early on (mid-90s). Soon I was keen to work on technologies which drove the internet. I have mostly been on the software development side in telecom equipment manufacturers (TEM) though I have also worked on network planning/deployment.

What are the required skills set?

Veer Chand Bothra: To be a part of this industry, and survive, one has to have an inherent desire to learn (and learn endlessly), because whatever technology you may be working on today will be old tomorrow. Hard work is another pre-requisite. If you have the tendency to put off work, take your own time in learning, this is not the place for you. Also, you have to have customer-oriented thinking. A bachelor's degree in engineering is required for most fields listed above.

Required mind set

Veer Chand Bothra: The mind set required is very open to learn and change. Maybe a new technology a day! You have to keep your mind adaptable to the ever changing pace of the industry.

One could always move to network deployments or in defining the standards. This takes a lot of effort to master a field completely. Also, one can move from a TEM to an operator to an integrator.

There are tremendous prospects both at the entry and at the middle levels. The emerging hot areas in this profession are: convergence – IMS, IP on the backhaul, etc; wireless 3G/4G/LTE, web applications that solve communication-related problems.

"The student should be strong in Physics and Mathematics. Ideally, good mathematical analysis, programming, signal processing, concepts of telecom should be focused on. Communication today drives society. A student gets a decent idea on how these work. Also one must understand how communication works over the cell phone, internet and TV. We receive as low as 10 to the power of minus 14 Watts of power at handset and it still works.. How and why need to be thought about!," says Ashok Jhunjhunwala, IIT-M.

Types of employers

- ☐ **Service provider**

People who understand the box applications of infrastructure are needed in this department. These people go out and create the infrastructure.

  - ○ Sales guys for equipment – you need engineers who can sell
  - ○ Administration people – who are familiar with the industry and look at expanding
  - ○ People for the maintainence of infrastructure
- ☐ **Manufacturing of equipment**
  - ○ System design of low level firmware/chipware
  - ○ Mechanical aspect for the box. People should be able to service and test.
  - ○ People to actually manufacture the equipment
- ☐ **Consumer-end**
  - ○ People who understand circuit boards and embedded software
  - ○ People who know operating systems and software
- ☐ **Services for the end-user (VAS)**
  - ○ People who can develop software applications

Service Provider

Examples: Airtel
Vodafone
Aircel
BSNL
Reliance

Manufacturing of equipment

Examples: Alcatel Lucent
Nortel
Ericsson

What makes people successful in this career?

According to Indu Kapoor, HR business partner, Research and Development, Alcatel Lucent, NCR Region, the people she has noticed to succeed in this field are those with the ability to analyse a problem and develop solutions quickly. These people have the constant need to learn. Once they have learned something new they should be able to figure out how to apply it. "Can they make their product faster, lighter, last longer? They should have the desire to improvise," she says.

For a leadership role, she points out that it is not critical for the candidate to have an in-depth knowledge in the domain. The leader does not have to get into code-level instructions, instead she says that they may have other abilities, like the ability to motivate people.

What are the alternate mid-career changes possible?

According to Indu Kapoor of Alcatel Lucent, telecom is not a sector that people leave very easily. Her reasons are that the nature of the job is just that exciting, and on top of this the pay is usually higher than other sectors.

VAS: Add value to your career

If you are the kind who isn't happy with just a pay packet, decent working hours and the usual perks a good job brings, think about a career in mobile Value Added Service (VAS). For it is exciting and fulfilling, allows you to work with innovation and different technologies in a fast-paced work environment along with the challenge of comprehending consumer behaviour and providing innovative solutions to cater to those niche requirements. It gives you the power to think beyond just communication! VAS is among the latest buzz word in the communications space and offers fast paced career growth and exciting opportunities for professionals interested in building a career in the booming communications tech space.

- Why bother?
  Experts forecast mobile VAS in India to be a 1 billion USD market by 2010 and create 75,000 to 1,00,000 jobs.
- How do I progress faster in this profession?
  An open mind to accept new technologies and willingness to learn
- What's in it for me?
  High growth career in a cutting edge field

What is it?

Mobile technology was introduced over a decade ago in India to facilitate communication — primarily with SMS and voice. However, over the years, mobile phones have become an integral part of our lives. A popular cellphone ad says: "It's who we are." And rightly so, for a simple SMS or ring tone or even our caller tunes reveal a significant part of our personalities. This is where the telecom companies are realising the potential of offering services beyond just being a way of communication.

However, mVAS comes at a price and cellular operators and service providers charge a premium rate for the services they offer other than basic communication. Some of the services include SMS (text messages), MMS (multimedia messages), USSD (unstructured supplementary services data), CRBT (caller ring back tone), video streaming , participation in polls and contests, location-based services, mCommerce (financial transactions), mobile advertisements, infotainment services (news, weather reports, songs, recipes), Instant messaging, content downloads (wallpapers, games, ring tones) and downloadable mobile applications.

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Those are only a few that come to one's mind the moment mVAS is mentioned. However, the list keeps changing as per the handset compatibilities and customer demands.

As an artist would create a new painting on each canvas, mobile VAS is also as creative and vast in its purview. You could be a writer of content, develop games for mobile phones, develop ecommerce platforms, technologies. In short, this career can be what you want it to be.

Today, mobile phones have become the primary source of entertainment and so consumer expectation is also shooting up with each passing day. Today, we check our emails on our phone. We also book movie tickets transact online through our cell phones.

The growth story

Mobile interconnected industries have been coming up with fresh and ground-breaking mobile technologies. Mobile VAS accounts for 10-12 per cent of total telecom revenues. There are over 375 million mobile subscribers in India, out of which 8-10 per cent are expected to be GPRS (general packet radio services) subscribers as well. With the launch of 3G services (faster data speed) in India, games download, mCommerce, video streaming, mobile blogs and mobile chat too are expected to grow.

As per TRAI predictions, mobile VAS revenue growth contributing to telecommunication industry is expected to grow to 30% in the next 5-7 years, which is way beyond the current contribution of 10–12%. Many experts are predicting mobile VAS in India to be a $1-billion market by 2010.

With the advent of mobile 2.0, cellular phones have become modes of emailing, social networking (twitter), seconds as a camera, a mobile wallet and much more.

As computers develop and new technologies come up in the computing world, there will be the demand to make them available on mobile handsets as well. And as projected by NASSCOM, the software industry is going to grow even in these recessionary times, mobile application and VAS industry will definitely follow suit.

Technology changes every day and thus pushes the sector to grow and change with it. Operators will have more and more mVAS requirements and one can expect to see a huge requirement of professionals in this space.

Currently, there are over 100 mVAS companies in India and the number is growing steadily. Experts expect the industry to grow at least ten fold (from the current estimate of 15,000–20,000 mVAS professionals) in the next 3-5 years. Even if we take a conservative growth of five times, we find a requirement of about 75,000 to 100,000 professionals in the next few years.

As most of the telecom operators are based out Mumbai and NCR many organisations are coming up in these geographies. With telecom sector booming in India, this area is expected to see an unprecedented growth in terms of investment in research, development on one side and consumer spending and new business offering on other.

Types of careers

☐ **Content Developers / Owner** – These are jobs with companies such as Saregama and Mauj that seek specialists in developing copyrighted content. Typical roles available are of content executive, senior content manager and project manager depending on skill and qualifications.

☐ **Aggregator** – An aggregator is a company that would aggregate content such as games, wallpapers, ringtones and distribute it to suit customer needs and demands. Typical players here are Hungama Mobile and Indiatimes mobile. Most roles here would be of project managers and business development managers and requires individuals with a business mindset.

☐ **Software developer (Development Houses)** - Software houses developing cutting edge technology and applications such as payment gateways and games. Some players are mchek and Webaroo. Most roles here are of software developers, mobile game application developers/testers, BREW/iPhone/Android Application programmer, etc.

☐ **Technology Platform Developers/Enabler** - Provides the platform that plugs into the telecom company networks and acts as a bridge between aggregator and telecom companies. Some players include OnMobile and Cellnext. Some of the latest innovations include contextual mobile advertising and media streaming over handsets.

Some other roles that will require many qualified professionals are in mobile development, vendor management, enterprise solutions, key account management and product managers, deployment specialists, across operators and enterprises.

The career paths are typically standard. For example, a fresher would join as a Junior Developer then go on to become a Senior Developer, Technical Lead and then Manager.

The industry is flexible and open to fast learners. You could also be an entrepreneur as long as you have got the next killer application.

Why I chose this career?

Five years ago, I was working with internet ventures and I was smitten by the thought that "mobile phones will be the PC for India". In USA, the PC is the lifeline for people. However, in India the highest penetration was by mobile phones. I am driven by the thought of what can be done with the power of a mobile phone looked at as an Internet-connected PC. I chose this career to create different applications for the Indian audience through their mobile device.

Face-2-Face with practitioner

"My role is all about making the consumer look at his mobile phone look like an internet-connected PC and help them maximise its benefits."

Veer Chand Bothra
Founder, Revience

Employers

Hungama
Mobile2Win
Mauj

Face-2-Face with Employer

"Compensation grows with time and reponsibilities. Years of experience is given less weightage than the output/skills of a person."

Ajay Pandey
CEO of Mastif

What are the required skill sets?

All mobile application courses have a pre requisite that students need a strong knowledge of software languages (C, C++, Java) and knowledge of mobile phone software application. In most job openings, it does not specify the requirement of a specific mobile application course.

According to Bothra, the most important skill is to "learn how to learn". This industry is really about breaking the barriers of the mind and thinking innovatively. It is all about having the passion to spend ten hours with your mobile phone without talking or sending an SMS on it.

Further, Siddhartha Singh who is a Senior Technical Manager at Mavenir Systems, believes: "The key success factor in this career is to accept change. You cannot restrict yourself to only one technology. For instance, there are certain platform where only Java works whereas on a Windows platform it is mostly .NET. Similarly, in Symbian there are many other choices. So one must be open to accept that technologies change at a very fast pace".

Ajay Pandey, the CEO of Mastiff advises anyone in this space to constantly keep tabs on what is happening on the global front. From there aim to match your idea or creation with the global standards. Keeping updated on new technologies is essential to staying ahead. Work hard and finish one product cycle, do not leave in between.

What is the required mind set?

The industry changes so rapidly that you have to be open in your thinking and adaptable to change every minute. Thinking beyond what you see today and believe in creating a difference. You have to feel challenged enough and desire to be different. The key to this career is to not have a mind set.

Sample Job Description

- 8+ years of GSM / CDMA / WCDMA and wireless technologies
- Understanding of different network elements and services – voice, data, broadband
- Expertise in designing end-to-end VAS solutions
- Understanding of network elements
- Expertise in telecom business understanding
- Experience in SOA technology
- Experience across different technology stacks – Oracle/Microsoft/UNIX Administration
- Experience in end to end delivery of at least 2 VAS engagements
- Experience in execution of telecom operations
- Excellent communication skills, good leadership skills

Animation and Game Development

Don't even bother reading this career feature unless you've watched cartoons or played video games for a large part of your leisure life. You need to have spent a considerable amount of time lost in virtually-constructed worlds to excel at these professions. It's homework most people will not shirk.

- Why bother?
  Animation industry to reach $1.16 billion of revenues by 2012
  Gaming industry to reach $1.06 billion of revenues by 2012
- How do I progress faster in this profession?
  Animation: The ability to act. Exposure to world
  Gaming: Exposure to gaming across platforms and genres
- Where am I ten years from now?
  Head of design, Game director
- What's in it for me?
  Very interesting and challenging profession

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What is it?

A career in animation and game development means you become the person who constructs the characters and environments and then go on to make these two elements interact with each other. The computer-generated environment or the visual elements is what these two areas share in common. Their difference is that animated entertainment is a passive medium, while games are interactive. This adds one more element to gaming, which is programming.

Philip Edward Alexy, professor at *Picasso Animation* says, "The gaming industry has evolved over the last few years from simple bitmap pixelated scrollers and mindless killing-spree first-person shooters, to involving cinematic narratives where the players becomes one of, if not the only, major characters of that narrative. No longer is the majority of system resources being used to simply run the gaming engine. Now the actual artistic content can be as close to photorealism as one would see on television."

Why is it needed?

The outsourcing industry has attracted plenty of animation and game studios to send work over to India. There is some fantastic work being churned out at the numerous studios around India.

The gaming industry is a relatively new entrant in India. This is largely because the video gaming phenomenon is relatively new to India. Therefore, there is a serious lack of game production professionals who are gamers themselves. This lack of exposure is a major weak point. This is, therefore, the first USP that you have, as a gamer, over most of the game production professionals in India.

Animation requires a familiarity with the English language. This gives India the advantage for more outsourced work. Most animation studios in India are creating skilled manpower for the animation market through various training programmes. Besides this, we also have a large pool of low-cost, high-quality software engineers. A number of Indian animation companies have set up hi-tech studios manned by such engineers.

A US-based animator can cost about $125 an hour. However, an Indian animator costs $25 an hour. *Toonz Animation* offers animation at 25 per cent to 40 per cent lower rates than other Asian studios and much lower than those of American studios. The total cost for making a full-length animated film in America is estimated to be $100 million to $175 million. In India, it can be made for $15 million to $25 million. All these factors point to the fact that the animation-outsourced industry is set to grow.

Rajesh Rao, founder of *Dhruva Interactive*, India's first development gaming studio addresses the gaming scenario. According to Rao, "With the often quoted statistics of 350 million young Indians between the age of 15 and 35, there is definitely huge potential. I mean, China has a 3.5 billion dollar industry and it just happened in the last 8-9 years. In India too, things are bound to improve, especially with such disposable incomes. It'll be among the top 3-4. People who join now, have an early day entry. They will have experience. By the time the demand grows, the market increases, they will be industry champions. Especially, as the factors that enable such a thing are coming together: with internet penetration and cheaper computers there would be 20-25 million broadband subscribers just as the mobiles are growing constantly."

The growth story

IT industry body NASSCOM has projected the Indian animation industry to reach $1.16 billion of revenues by 2012. The industry is currently worth $460 million and is expected to grow at a CAGR (Compound Annual Growth Rate) of 27%.

Custom content development is the largest segment as of today, with an estimated industry size of $187.5 million while animation education is slated to be the fastest growing. The report expects the gaming industry in India to reach $1.06 billion of revenues by 2012 from its current $212 million.

"The global animation and gaming industry has been growing at a CAGR of almost 8-10 % and this billion dollar industry has great scope of employment for those who are ready to try their skills in it. This industry has also been fairly recession resistant, if not recession proof and will continue to see demand over the next 3 years," says Tapaas Chakravarti, CEO of DQE.

What are the related paths in this career that you can pursue?

- Programmers
- Artists
- Designers

The main thing is the intrinsic talent. Besides having a Bachelors' in Science, an Engineering in Computer Science with a background in Maths and Physics helps. Main knowledge is important and less stress on tools will do. All these three kind of profiles work together in a team.

Talent is the key, experience not as important.

What do you do in your studio?

Vitek Goyal, CEO Pixeltek: We work on 3D graphics and video game development, mainly catering to game developers. We help in outsourcing and streamlining. We are a small team of 12 people. Instead of the whole game, we do a part of it, like character and asset building.

How did you get into this field?

Vitek Goyal: I used to love playing video games. I mean since I was young. Then, I went on to get a degree in Interactive Arts from New York. At that time I was still a layman with no technical know-how. After I returned to India, I started reading articles doing research on game developing. After which I advertised in a paper and this was pretty much the road map of the company.

Why did you choose this career?

Vitek Goyal: We are always racing against crazy deadlines. And within that time to come up with results that are brilliant is quite a high.

With these unique highs come the benifit of seeing tangible results. It's rewarding to see your mention in the credits, to see your product on a shelf. To know that all the hard work you put into it has culminated into something that people would enjoy. This profession also gives you a chance to interact with people from abroad, meet different kind of mindsets, etc. It's worth it.

Face-2-Face with practitioner

"Do it. It's not for everyone. It sounds really good and fun, which it is, but also a lot of hard work. But if you love gaming, you'd enjoy it."

Vitek Goyal
CEO of Pixeltek

What are the required skill sets?

For Animators:

Somil Gupta, Managing Director, Trine Studios: "For this role we look at people who can sketch and paint. On top of this we look for people who have explored art-styles from all over the world. In the past, we have seen that when we ask an artist to create a western-styled character, they just cannot pull it off. This is because they haven't practiced their hand at different design styles and have stuck to what they learnt in art school," points out Somil Gupta, the Managing Director at Trine Studios in Mumbai.

Vinod AS, the National Head of Academics with Toonz Academy says that besides people who can just draw, the animators who have the real advantage are those that have acting skills. That's right. You read that right. Acting. "The animator himself is an actor. We've noticed that the students that are good at mimicry tend to make better animators. They could be very bad artists, but if they can act, they still make excellent animators. Let's say he wants to design a monkey. Then the artist should be able to imitate the way a monkey walks and behave to be able to recreate it," he says.

"You just cannot ask the computer to come up with, let's say, a Victorian steampunk spaceship or a psycho-killer alien-robot assassin. You need artists to create this content and since we are rapidly approaching the point, if not surpassed it, where one can almost interchange the experience of watching a film or playing the newest chapter of the Resident Evil franchise. So we offer instructors that have industry experience in how to make a texture for that evil castle or create a walk-cycle for the muscle-bound hero for the latest and newest video game release," says Philip Edward Alexy, professor at Picasso Animation, touching upon animation in video games.

For Game Production:

Vitek Goyal, CEO Pixeltek: Not necessarily a Master of Fine Arts degree. Diplomas, tutorials are great to have, but it's the interest that you take in it.

Christopher Erhardt, founder Indian School of Gaming points out that candidates should focus on their math and English. The reason for this is that most game programming is math and all the major programming languages currently are in English.

Also, strong C/C++ programming at all levels coupled with good knowledge of linear algebra, calculus, written English and some skills at Flash/BREW/Java in addition to the C++ is needed for game programming. C# is as an emerging language for this space as well.

What is the required mind set?

- Having the desire to learn

Employers in India

Animation:

Toonz Animation India, Thiruvananthapuram
Pentamedia Graphics, Chennai
Maya Entertainment, Mumbai
UTV Toonz, Mumbai
Heart Entertainment
Padmalaya Telefilms, Mumbai
Nipuna Services Ltd.
Jadoo Works, Bangalore
Crest Communications, Mumbai
Silvertoon Studio, Mumbai
DQE, Hyderabad

Gaming:

Aurona
Trine
FX Labs
Exigent
Pixeltek
Zapak Digital Entertainment Ltd.

- Being a self-starter
- Having an aptitude for quality and detail
- Be committed to meet deadlines and work under minimal guidance
- Intrinsic talent is one of the key thing besides the commitment
- The ability to take constructive criticism can take you far in this profession
- The ability to give feedback without seeming condescending especially when you working in a team
- Exposure to technology and your own desire to learn can get you far in the industry

Christopher Erdhardt, founder of the Indian School of Gaming says what the gaming industry needs is "Nerds. No, seriously, math geeks that are fans of games other than *Counter-strike* and *NFS*. Remember that the bulk of games sold in the USA and UK are family-friendly casual games. So someone open to new types of games excels." Game design is where most gamers would jump for. This requires a far more subtler skill. Rajesh from Dhruva illustrates, "If you've played a lot of games from beginning to end, you start understanding the ladder of challenge. You understand the different learning curves for different kinds of games. For instance, as a writer, it helps if you did a lot of reading in your formative years. It works exactly the same way with gaming. You can't have a guy who has spent years in the creative department of an advertising agency pop-out and say he'll design a game. This sort of person would stick to a linear form of story telling and gaming has gone beyond this."

It's different disciplines. Individual contributor is mainly it for the first couple of years. Then highly specialised contributors then mentors and managers, assistant leaders, project management etc.

Face-2-Face with Employer

"We accept people from multidisciplinary backgrounds. Artists, programmers, sound engineers. None have had any formal education in this regard. With no industry relevant courses, the onus strangely lies on the industry itself to train in industry-relevant skills,"

Rajesh Rao
Founder of Dhruva Interactive

Compensation

Early on, it could be approximately Rs 10,000-15,000. Further, Rs. 20,000- 40,000 or so in 2 years and anywhere between Rs. 40,000 to 50,000 in the fourth year. Rs. 50,000 to 70,000 from 5th year onwards. *Please note: These figures do not represent the compensation package of any one company. It is an approximate based on discussions with experts across companies.*

Mid-career changes

According to Rao, "Programmers do not exactly change careers after sometime. While we do notice depending on the interest that designers and artists make a switch. Sometimes designers take up arts and the other way around."

Institutes offering Animation and Game-related courses:

- Academy Of Animation And Gaming, Noida
- AIGA – Asian Institute Of Gaming And Animation, Bangalore
- Animaster, Bangalore
- Ants Studio Pvt. Ltd., Bangalore
- Aptech Limited (Arena Animation), Mumbai
- Arena Animation, Indore
- Arena Multimedia Park Street, Kolkatta
- Dsk Superinfocom International Campus, Pune
- Frameboxx Animation | Visual Effects, Mumbai
- Gecko Animation Studio, New Delhi

- Image College Of Arts, Animation & Technology (Icat), Chennai
- Industrial Design Centre, IIT Mumbai
- Indian School of Gaming, Hyderabad
- MAAC, Mumbai
- Manipal University, Karnataka
- Midds Medeor Institutes Of Digital Design Studies, Mumbai
- Picasso Animation College, New Delhi
- Race-the Animation College, Hyderabad
- Ready To Go Animate, Kolkatta
- Takshaa, Bangalore
- Toonz Academy, Chennai
- Whistling Woods International, Mumbai
- Wiztoonz Animations Private Limited, Bangalore
- Xplora Design Skool, Ahmedabad
- Zee Institute Of Creative Arts, Mumbai
- National Institute Of Design, Ahmedabad

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Computer Security and Forensics

As we move our lives online, we see an increase of crimes in this space. The more we depend on computers and the networks that link them together, the more opportunities sprout up for the criminal mind. If you've ever met a cyber forensics specialist, or the head of research lab in a security company you would have sensed the nature of a crime-fighter. All of them speak with a passion that is truly inspiring. After all, their job is about the epic clash between good and evil.

⦿ Why bother? NASSCOM estimate: world-wide demand for 2,00,000 security professionals; 90,000 in India	⦿ Where am I ten years from now? Security Advisor
⦿ How do I progress faster in this profession? IT Background+ knowledge of cyber law. The ability to think like a criminal, attention for detail	⦿ What's in it for me? An extremely interesting profession

What is it?

It is one of Rakesh Goyal's most memorable cases. He recalls when one of India's well-known banks received a complaint from a clerk, stating that there may have been an accounting error in the charge of interest rates on overdrawn accounts. A few accounts showed the charge to be just 5 per cent, when the bank's charge was 10 per cent. The resulting difference ran into several lakhs of rupees. The tedious task of checking all records was done and nothing seemed amiss. Yet the money was missing. This is the point at which Rakesh Goyal's firm, *Sysman*, was called in. His firm specialises in the detection of cyber crimes.

They stumbled across the possible tool of attack when they ran a check through the 259 programs that the bank used. In this list they found nine programs that were not in the official list of software. On testing them, it was found that three of them accessed the database and produced no audit trail. The firm came up with the hypothesis that someone could have briefly reset the interest rates. The only possible time that these alien programs could have got into the bank's network was when they did their last upgrade. This helped them zero in on the day of the attack. This also helped identify the accounts involved. The officer staffing a particular desk was questioned. They put him in a room, asked him a few questions and he cracked. It didn't take much of an effort to make the man talk once the heavy-lifting of studying the systems was complete.

Simply put, computer/cyber security is the science of protecting the data residing on our computer systems and networks from unauthorised access, disclosure, transfer and modifications, whether accidental or intentional. It could be as simple as installing an anti-virus program on your desktop to installing firewalls and honeypots at the network level. It could also be the task of tracing the crime, such as the above example.

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Why is it needed?

Just as each stride ahead in this information age enables us to transfer information more freely and have better and faster access to knowledge, security of this information also becomes a key issue. Computer security is required at all levels — personal, corporate, state or country. Protecting data in today's environment has become a greater concern and a formidable task to undertake.

A cyber-criminal or hacker could strike in many different ways. He could unleash a virus attack to erase your entire system, steal confidential information from your system or even break into your system and modify your files without your knowledge.

A computer security professional does a similar job, albeit ethically. He thinks like a hacker so as to find loopholes in the data and systems in the network and pre-empt a hacker's moves. He then puts in place a security program to deal with the myriad of threats present for any infrastructure. There are many courses available nowadays that offer courses in "ethical hacking".

Computer Forensics is still a rather new discipline in computer security and is a rapidly growing discipline that focuses on finding digital evidence after a computer security incident (breach) has occurred.

The role of a Computer Forensic professional is to collect and analyse digital data within an investigative process and find out exactly what happened on a digital system and who was responsible.

There are essentially four phases for recovering evidence from a computer system or storage medium.

- The identification of digital evidence
- The preservation of digital evidence for judicial scrutiny in a court of law
- The analysis of digital evidence – the extraction, processing and interpretation of digital data
- The presentation of evidence in a court of law

Hundred per cent data security is a myth. The rapid evolution of computer technology implies that computer security professionals, despite being on constant vigil, may not be able to anticipate and prevent all attacks.

However, it is said that computer criminals always leave tracks; it's only a matter of finding them. But this part is not always easy. If computer forensics collects evidence correctly, it is much easier to apprehend the attacker and the evidence stands a greater chance of being admissible in the event of a prosecution.

Some organisations have put in place an 'Incident Response Team' whose role is to investigative in case of a computer security breach; this also involves problem-solving. It includes management personnel with the authority to take action, technical personnel (computer security professional and/or computer forensic professional) with the knowledge and expertise to diagnose rapidly and resolve problems, and communications representatives who can keep the concerned individuals and organisations informed on the status of the problem and develop public image control strategies, if necessary.

Face-2-Face with practitioner

"My profession is IT Security. It is more a profession than a business. Yes, it is representative of career in IT security and forensics. In my profession, my job is to secure the IT assets of the end-user."

Rakesh Goyal
Sysman India

The Growth Story

According to a NASSCOM estimate, the world-wide demand for computer security professionals would touch about 2,00,000 by next year. In India alone, the demand should touch a whopping 90,000 and there would be a shortfall of 35,000 to 45,000 computer security professionals.

International Data Corporation (IDC) had predicted that the worldwide information security market would increase from roughly $6.7 billion in 2000 to $21 billion by 2005. In the financial services industry alone, the spending on security-related products and services was expected to rise from $848 million in 2000 to $2.2 billion by 2005. Thus, there is a sizable requirement for cyber security products and services.

Key drivers of growth

The demand for professionals in this field is rising for two reasons:

1. Increasingly data is being stored outside the organisation
2. Internal data theft

There has been a steady rise in cyber attacks (28 per cent in the first six months of 2002). According to a survey in 2001, cyber attacks cost businesses roughly $13.2 billion in damage and clean-up costs while in the preceding year, it was $17.1 billion. Some institutions were even forced to shut down their entire networks to fix the problem.

In response to this, organisations and governments are gearing up to take necessary preventive and remedial measures. India has recognised cyber crime and necessary security actions are being taken on the government and personal level. As social and government awareness about cyber security increases, job opportunities for computer forensic and security experts will also increase. As state governments are opening cyber crime departments, this will also bring more job openings.

Rakesh Goyal, is the founder of Sysman India, a cyber security firm. He has been in the industry since 1991. He tackles some of our questions:

Why did you choose this career?

Rakesh Goyal, founder, Sysman India: Serendipity chose my career for me. I did my first forensics assignment by chance in 1991 and for free. That's when I realised that I have natural inclination towards IT forensics. It led to writing a book in 1993. Gradually, it became IT security over a period of time. In 2004, when IS security consulting became a lucrative business, software businesses were closed and efforts were diverted towards the IT security business.

Every case is unique and a challenge. No two cases / assignments are the same. So, it is a delight for any challenge-loving person. One gets to apply all the faculties at his or her command to secure the assets or investigate the case. In investigations, the person must think laterally like Sherlock Holmes.

What are the required skill sets?

Rakesh Goyal: A number of colleges and short-term courses have been launched which train a person on different aspects of computer security and forensics.

Based on the performance in exams and prior experience, certifications like CISA, CISM, CISSP are awarded. These certificates are recognised by the industry. No minimum qualification is required to appear for these exams.

For entry in the profession, one just needs an IT background with understanding of C++ and JAVA and preferably, knowledge of the law and business processes.

Required mind set

The most important ingredient for success is the mindset. To succeed, one needs to be a nit-picker and be able to think like a criminal.

One should be a constant learner as there is a need to update skills and knowledge on an hourly basis. For a person who is averse to reading / studying (and has cleared exams with keys / cramming), this is not the field to make a career in. It's a low profile job. One cannot talk to the press about an assignment; not even reveal a client's identity.

Sample job description

Position Title: Security specialist
Department: Engineering

Position Summary:

The candidate will be responsible for driving the adoption and evolution of security engineering best practices within local product development teams. This includes driving threat modelling activities, conducting technical security assessments at an architecture, design and implementation level, and providing technical security guidance and training to engineering staff.

The ideal candidate would be an experienced developer or security consultant with a solid knowledge of current security engineering practices and a detailed understanding of design and implementation level security vulnerabilities and mitigations. Hands-on experience developing or implementing a secure development lifecycle process, and conducting application level security testing, is also desirable.

Candidates with limited security experience, but with a strong software engineering background and a desire to move into a more specialised security engineering role will also be considered.

Primary Responsibilities:

- Security analysis of product architecture, design, and implementation
- Driving the adoption and evolution of security engineering best practices
- Identification and analysis of potential security vulnerabilities
- Identifying and driving longer term product and process improvements
- Making technical and business recommendations to product teams
- Providing technical guidance and security training to development teams
- Technical risk assessment
- Writing and reviewing product security bulletins

Required:

- Detailed knowledge of current secure development best practices
- Experience deriving threat models or attack trees
- Detailed knowledge of common software vulnerabilities
- Ability to identify and implement longer term product and process improvements
- Ability to derive and apply creative attack techniques
- Ability to analyse potential vulnerabilities to determine if an exploit is feasible
- Ability to analyse the risk presented by potential vulnerabilities
- Ability to clearly and effectively communicate with engineers and management
- Bachelors degree in computer science or related field

Desirable:

- CISSP/CSSLP/GIAC certification
- Detailed, low-level, technical knowledge of Windows, Unix, or Linux operating systems
- Hands-on software development experience
- Solid understanding of C/C++ development on Windows or Unix platforms
- Good understanding of Java or .NET and related tools and technologies

- ○ Experience developing and testing web-based applications
- ○ Experience with static code or binary analysis tools
- ○ Solid understanding of common networking protocols: TCP, IP, UDP, HTTP, SSL
- ○ Prior experience with security products

Face-2-Face with Employer

"These are one of the few businesses where you feel that you are not just working for a larger business, but where you are actually protecting yourself, your family, friends and the world itself. It becomes a fight of good versus evil, and hence gives you a sense of satisfaction that most jobs cannot,"

Request for Anonymity
Development Manager
MNC Security Company

A career in computer security isn't only about anti-viruses and firewalls anymore, it is now also about network security, data leak protection and security on the mobile phone as well. Network security is about tapping into a network to steal information. Data protection includes stealing data through a USB. Ram Chandra (name changed on request) interestingly points out that during the recession, a lot of people were laid off. A few of these disgruntled employees may have a tendency to do damage to the organisation.

Employers in security:

☐ **Organisations with an in-house security team:** most large organisations have a team dedicated to security from a desktop to the network level. Their responsibility is to keep the company's information intact. This could be the credit card information in a bank or a call centre.

☐ **Security companies:** companies such as Symantec, McAfee create security solutions at the desktop and handset level and even provide security solutions for other large companies

☐ **Private forensic firms:** These firms specialise in tracking down crimes in this space. Their role is to identify how the crime was done on a computer or network. Their role ends once they have cracked this. After this is done, law enforcement moves in to take action.

Possible mid-career changes

Rakesh Goyal, Sysman, believes that a career-change is an option at any point, if the candidate has experience in the business processes of a specific industry. That industry will always welcome any security-oriented person. A security specialist that specialises in a certain domain, such as developing security solutions for a network can always choose to go into a company that develops networking products. Likewise, someone specialising in mobile phone security can always switch to a handset manufacturer. However considering the interesting nature of the job and the competitive salary, this sort of switch is not very common.

Future prospects

As IT and IT assets are growing, so is the number of criminals. Thus, growth

Potential employers

In-house security division

This can be any of the large organisations where information holds high value.

Examples: HDFC, ICICI, Amazon.com

Computer security companies

Companies that specialise in various aspects of security. Specialisation ranges from desktops to handsets to networks.

Examples: McAfee, Symantec, F-Secure

Computer Forensics firms

Firms that specialise in cyber-forensic investigations

Examples: Sysman, Foundation Futuristic Technologies, Lab Systems (I) is immense and guaranteed. This field is yet to mature in India and there is space for growth.

Emerging hot areas

Where there is a computer, IT security is required. A lot is happening in IT criminology. Hot emerging areas are banking, eGov, health care, phishing, malware, training, investigation, etc.

Schools/certifications to consider:

- Sun Microsystems India
  Bangalore
- M.Tech (Information Security and Computer Forensics)
  Kancheepuram, Tamil Nadu
- M.Sc in Cyber Forensics and Information Security
  University of Madras, Chennai
- C-DAC's Course on Cyber Security
  Centre for Development of Advanced Computing, Hyderabad
- 6-month PG Diploma in Information Security and
  System Administration
  DOEACC, Calicut Centre
- Maulana Azad National Institute of Technology (Deemed University)
  Bhopal

Courses in cyberlaw are:

- Symbiosis Society's Law College, Pune
- Asian School of Cyber Laws, Pune

Growth path in a security organisation

Entry level
IS Executive Manager (role: to correlate broad security guidelines of the organisation with security operations.)

Middle level
IS Manager (role: security program management, data security, policy creation/maintenance, business continuity/disaster recovery)

Senior & top level
Chief IS Manager (role: design and development of information security policy. Regulatory compliance, information security governance)

Senior & top level
Security Advisors / Auditors (role: advisory services for information security, policy design, risk assessment, compliance with global/industry standards)

Senior & top level
Chief Information Officer (role: justifying the cost of ongoing and future investments to mitigate information risks, aligning business objectives with a concise security strategy)

- Indian Institute of Information and Technology, Allahabad
- Center for Distance Education, University, Hyderabad
- Amity Law School, Delhi
- Department of Law, University of Delhi
- National Law School of India, Bangalore
- National Academy of Legal Studies and Research University of Law, Hyderabad
- Cyber Law College NAAVI - Chennai, Mysore, Hubli, Mangalore, Bangalore

Please note: This list is not exhaustive and is compiled based on discussions of experts across industries

Resources for further reading

- http://snipurl.com/invx4
- http://snipurl.com/invxv
- http://snipurl.com/invyq
- http://snipurl.com/invzu

(Please note: This list is not exhaustive and is compiled based on discussions of experts across industries)

Samsung
ST MicroElectronics
Intel
JnK Bank
Pronto Networks
Sysman
Pixeltek

Trine
Indian School of Gaming (No logo)
Picasso Animation
Dhruva Interactive
Sonus Networks India
Alcatel Lucent
Revience (No logo)

IIT-M
Brocade Communications
.Mastiff (No logo)
Mavenir Systems
Evalueserve
The smart cube
NetApp

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